Bruker BioSpin

PEXMUX

PEXMUX 8/16 Control Unit

User Manual

Version 001

think forward

NMR Spectroscopy

This manual was written by

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1 General

1.1 Information About this Manual

This manual provides information that enables safe and efficient handling of the Parallel Excitation Multiplexing (PEXMUX) Unit, which is used in MRI **AVANCE III** spectrometers. This manual is an integral part of the device, and must be available where it is permanently accessible to personnel.

Before starting any work, personnel must have read the manual thoroughly and understood its contents. Compliance with all specified safety instructions and operating instructions is vital to ensure safe operation.

In addition, local accident prevention regulations and general safety instructions must be observed for the operational area of the device.

Illustrations in this manual are intended to facilitate basic understanding, and may differ from the actual design.

1.2 Explanation of Symbols

DANGER

Type and source of the danger

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

- ▶ Countermeasure 1
- ▶ Countermeasure 2
- ▶ ...

WARNING

Type and source of the danger

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

- ▶ Countermeasure 1
- ▶ Countermeasure 2
- ▶ ...

⚠ CAUTION

Type and source of the danger

Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury or major material damage.

- ▶ Countermeasure 1
- ▶ Countermeasure 2
- ▶ ...

NOTICE

Type and source of the danger

Hazard, which could result in material damage.

- ▶ Countermeasure 1
- ▶ Countermeasure 2
- ▶ ...

References, which facilitate the work for the user.
Notes for the optimal use of the unit.

1.3 Limitations of Liability

All specifications and instructions in this manual have been compiled taking account of applicable standards and regulations, the current state of technology and the experience and insights we have gained over the years.

- The manufacturer accepts no liability for damage due to:
- Failure to observe this manual.
- Improper use.
- Deployment of untrained personnel.
- Unauthorized modifications.
- Technical modifications.
- Use of unauthorized spare parts.

The actual scope of supply may differ from the explanations and depictions in this manual in the case of special designs, take-up of additional ordering options, or as a result of the latest technical modifications.

The undertakings agreed in the supply contract as well as the manufacturer‘s Terms and Conditions, Terms of Delivery, and the legal regulations applicable at the time of conclusion of the contract shall apply.

1.4 Spare Parts

Spare parts may be obtained from authorized dealers or directly from the manufacturer. See "Contact" on page 35 for the address.

1.5 Warranty Terms

The warranty terms are included in the manufacturer‘s Terms and Conditions.

1.6 Customer Service

Our customer service division is available to provide technical information. See for "Contact" on page 35 contact details.

In addition, our employees are always interested in acquiring new information and experience gained from practical applications; such information and experience may help improve our products.

General

2 Safety

This chapter provides an overview of all the main safety aspects involved in ensuring optimal personnel protection and safe and smooth operation.

Non-compliance wit the action guidelines and safety instructions contained in this manual may result in serious hazards. Before starting any work, personnel must read this chapter thoroughly and understand its contents.

2.1 Intended Use

The unit has been designed and constructed solely for the intended use described here.

The PEXMUX units must only be used for the limited purpose of splitting the available IPSO TX-controller LVDS channels in Bruker AVANCE III spectrometers.

Intended use also includes compliance with all specifications in this manual.

Any use which exceeds or differs from the intended use shall be considered improper use.

No claims of any kind for damage will be entertained if such claims result from improper use.

2.2 General Safety Instructions

The PEXMUX can be damaged by inappropriate usage. In this case the equipment must not be used until it has been checked service personnel.

The user should re-check the equipment at regular intervals for any damage or wear and is expected to inform the service immediately of any abnormality.

Do not operate the equipment in the presence of flammable gases or fumes.

⚠ WARNING

Material or personnel damage from worn or damaged parts.

Damaged or worn parts may result if one or the following circumstances occurs:

- The power cord, power plug or power supply are cracked, brittle or damaged.
- Signs of excessive heat appear.
- There is evidence or suspicion that a liquid has intruded into any enclosure.
- The power cord or the power supply have been in contact with any liquid.
- The PEXMUX has been dropped or damaged in any way.
- The equipment does not work correctly

In the unlikely event one of the above occurs:

- Stop using the equipment.
- Disconnect the power supply.
- Inform service and ask for instructions.

i Only trained service personnel are allowed to mount, retrofit, repair, adjust and dismantle the PEXMUX. Do not try to service the equipment unless you are specifically asked to do so and are given instructions by the service staff. In case of questions or problems, please contact your nearest Bruker office or representative.

i Before maintenance, repair or shipment, the PEXMUX Unit must be completely disconnected from the power supply and dismounted from its rack.

3 Technical Data

3.1 General Information

Specification	Value	Unit
Weight	2.5	kg
Length	46.2	cm
Width	29.0	cm
Height	4.3	cm

3.2 Utility Requirements

Ingress Protection Class:	IP 20, secured against touching dangerous points inside, not secured against ingress of water.
Over-voltage Protection Category:	CAT II, according to EN61010–1or IEC60664–1 safe against over-voltage by switching, not safe against lightning. Surge immunity of PSU is level 3, according to IEC61000–4–5.
IEC Protection Class:	Class I, according the IEC 61140, connected to mains by phase, neutral and protective earth.
Input Voltage Range:	208 V to 230 V.
Frequency:	50/60 Hz.
Input Power:	30 VA.
Fuse On Mains Input:	250 VAC 2 A.
Connection:	Socket outlet with phase, neutral and protective–earth according to VDE 0620–1.

3.3 Operating Conditions

3.3.1 Operating Environment

Permissible ambient temperature:	5°C to 40°C.
Permissible altitude:	Up to 2000 meters above sea level.
Relative humidity:	Maximum of 80% for temperatures up to 31°C, linearly decreasing to 50% at a temperature of 40°C.
Permissible storage temperature:	5°C to 40°C.
Pollution degree:	The acceptable pollution degree is 2. According to EN 61010-1 or IEC 60664-1. Any pollution is non-conductive, except condensed moisture.

4 Design and Function

4.1 Product and Manufacturer

Product:	PEXMUX 8 Unit P/N H12592 PEXMUX 16 Unit P/N H12602 PEXMUX Board P/N H12538 CPU-A Board P/N W1522044
Manufacturer:	Bruker BioSpin GmbH Silberstreifen 4 76287 Rheinstetten Germany
Conformity:	EN 61010-1

4.2 General Description

The PEXMUX is available in two configurations:

- PEXMUX 8
- PEXMUX 16

Each PEXMUX unit is built in a 1HE 19” cabinet and includes:

- the PEXMUX board (P/N H12583),
- the CPU–A board (P/N W1522044) and,
- a power supply.

The **PEXMUX 8** Unit (P/N H12592) contains one PEXMUX board and the **PEXMUX 16** Unit (P/N 12602) includes two PEXMUX boards.

The PEXMUX is realized as a splitter to connect one FCTRL to up to 16 SGU's (up to 8 on each PEXMUX board).

Special MRI applications use the PEXMUX unit for parallel excitation sequences.

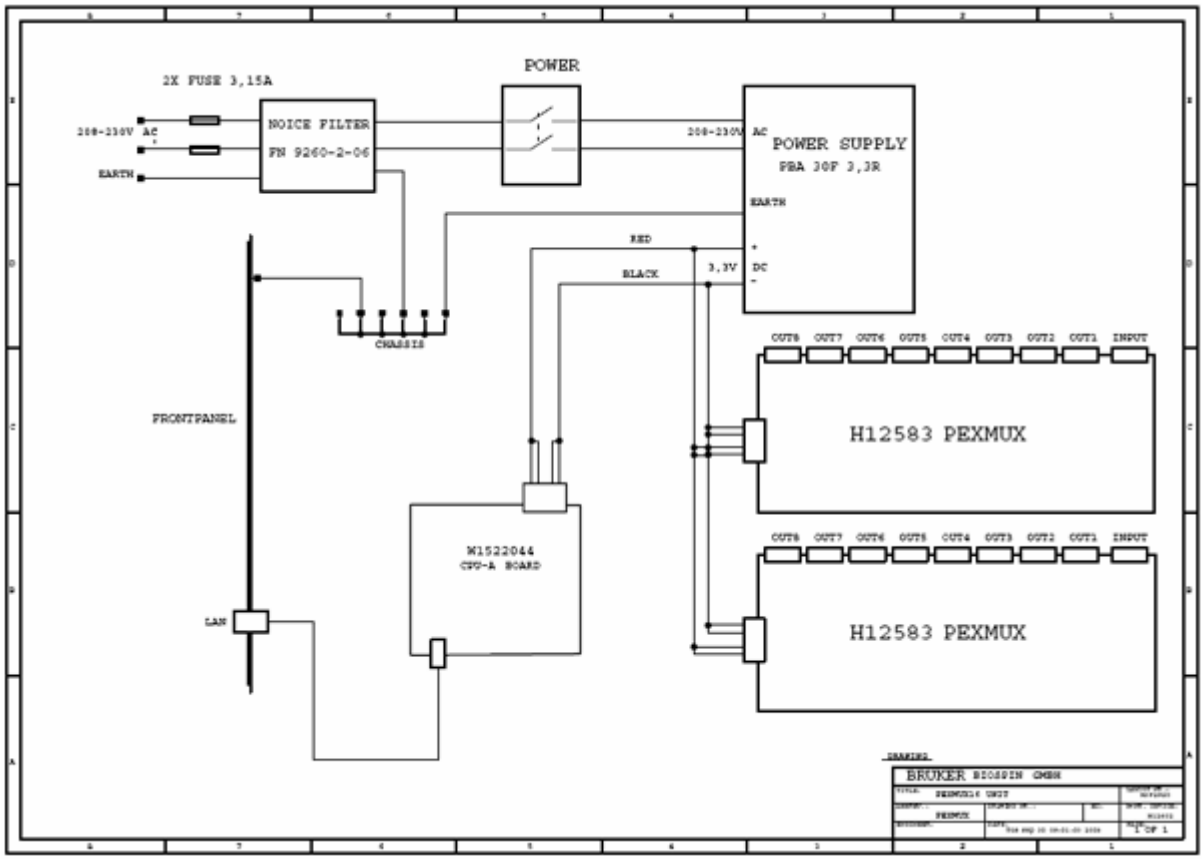

Figure 4.1 The PEXMUX Unit Wiring

4.3 Features

- The PEXMUX 8 Unit has a 48-Bit LVDS receiver input and 8 x 48-Bit LVDS transmit channels working at 80 MHZ.
- The PEXMUX 16 Unit has two 48-Bit LVDS receiver inputs, each with 8 x 48-Bit LVDS transmit channels working at 80 MHz.
- The units have two operation modes:

  Parallel Mode: All selected outputs are updated with the input value.

  Serial Mode: The selected channels will first be successively preloaded and the updated simultaneously.
- Minimum duration is 25 ns in parallel mode; Maximum duration is 200 ns in sequential mode if 8 channels are in use.
- Minimum resolution is 12.5 ns.
- The time gap between receiving and sending of the first LVDS frame is 225 ns.

4.4 Functional Description

The PEXMUX units receive data from the IPSO FCTRL and distributes the data to the 1–8 LVDS outputs (depending on the configuration). The whole logic is implemented in an FPGA (Altera Cyclone).

The unit is controlled in real time from the pulse program sequence by the register bit (9:0) of the LVDS A–Word and the REG_Val bits (1:0) of the B–Word which are send by the IPSO FCTRL.

Bit	Field	Number	Splitter Information
48	PAR	1	
47	SYNC	1	
46	WID	1	0
45	PLS	3	x
44	PA		x
43	A		x
42	REG 9:0	10	x
41			Update
40...33			8 selection bit
32...17	PHASE 15:00	16	x
16...1	SHAPE 15:0	16	x

Table 4.1 LVDS Word Structure Word A at the LVDS-Interface (Transfer FCTRL to SGU)

Bit	Field	Number	Splitter Information
48	PAR	1	
47	SYNC	1	
46	WID	1	x
45	NCO_SEL 2:0	3	x
44			x
43			x
42	REG_VAL 1:0	2	0
41			0
40	F_VAL 2:0	3	x
39			x
38			x
37	PH_VAL 1:0	2	x
36			x
35	SH_VAL	1	
34...1	F_DATA 33:0	34	x

Table 4.2 LVDS Word Structure Word B at the LVDS-Interface (Transfer FCTRL to SGU)

1. The Register Bit “Reg 9:0” includes the information to preload the selected output register, if Reg_Val 1:0 = 0. If the update bit is set the preloadet register will than be transferred to the LVDS output. The selection is stored until a new mode command with Reg 9:0 ≠ 0 is received. The data transferred via the PEXMUX will have a constant delay of 225 ns independent of the operation mode (parallel or serial).
2. If Reg_Val 1:0 ≠ 0 or Reg_Val 1:0 = 0 and Reg 9:0 = 0 than the received LVDS frame (A–Word, B–Word) is transferred to the preselected LVDS outputs.
3. If the update bit appears before 8 LVDS frames (A–Word, B–Word) are received (serial mode) than the output to the SGU is delayed, so that the time from receive to send is always 225 ns.

The decision table below shows the controlling of the register:

	Reg_Val 1:0	**Reg 9**	**Reg 8**	**Reg 7:0**	**Description**
		Mode	Update	Select-Bits	
Parallel	≠ 0	x	x	x	In default mode, after power-up, only the register 1 is selected and any incoming data is transferred to Out1. The frame (A/B-Word) is shifted through the register array and transferred to the output after 200 ns. LVDS input (A/B-Word) will be loaded in the preselection register controlled by the command below.
	= 0	x	x	<= 0>	
	= 0	1	x	<selection>	Depending on the <selection> the frame (A/B-Word) is loaded in the appropriate register, parallel shifted through the register array and transferred to the output.
Serial	= 0	0	0	<≠ 0; 1 out n>	The first frame (A/B-Word) is loaded in the first level of the selected register.
	= 0	0	0	<≠ 0; 1 out n>	The second frame is loaded in the first level of the selected register.
	= 0	0	1	<≠ 0; 1 out n>	The third frame is loaded in the first level of the selected register array and then (because the update bit is set) the preloaded words of level 1 are shifted to level 3. The data (all 3 frames) then shifts 5 levels further before sending parallel to the outputs.

Table 4.3 Loading the PEXMUX Register Array

4.5 The PEXMUX Board H12583

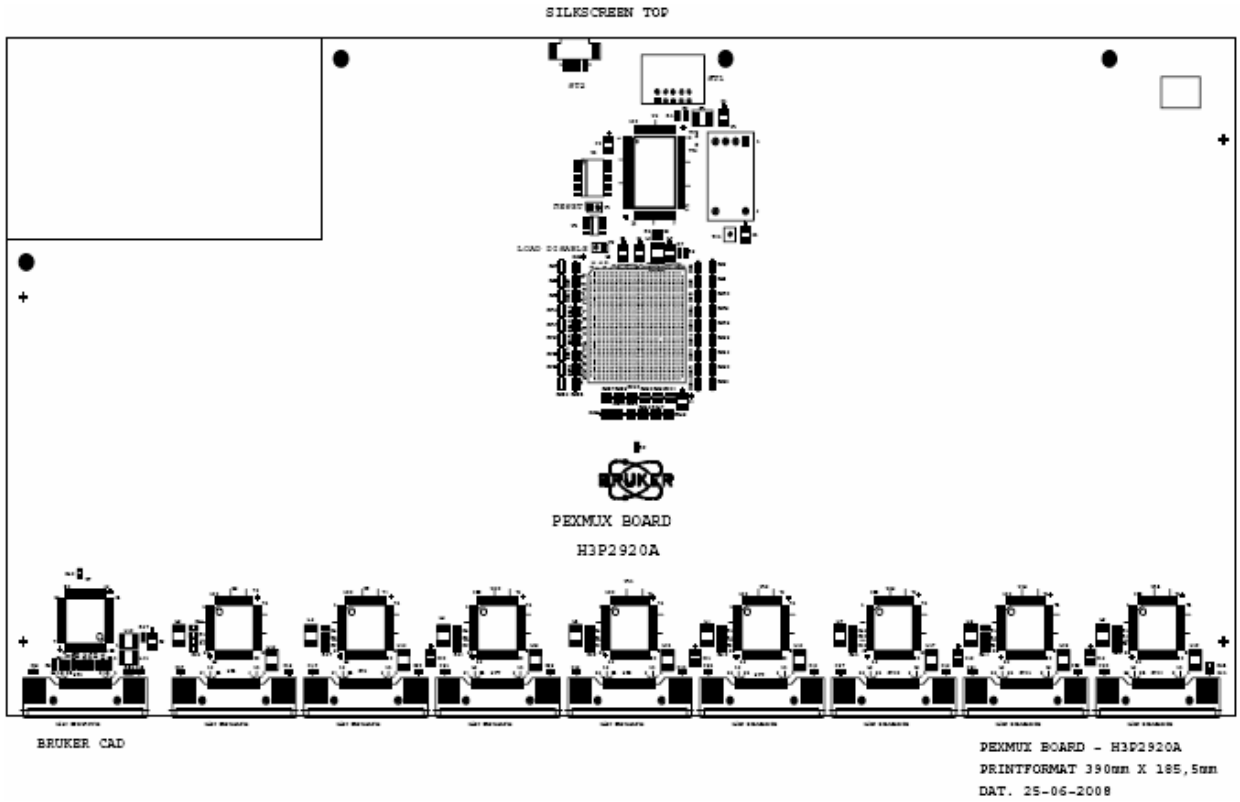

Figure 4.2 PEXMUX Board

4.6 JTAG Structure

The board possesses a JTAG interface which can be used for programming and testing.

Connector	St1
JTAG Chains	
Devices	U3: Configuration - EEPROM EPC8
	U6: FPGA EP2C70

Table 4.4 JTAG Structure on the PEXMUX Board

Pin Number	Signal		Pin Number	Signal
1	TRST*		6	JTAG Power +5V
2	Cable Detection		7	TMS
3	TDO		8	GND
4	GND		9	TCK
5	TDI		10	GND

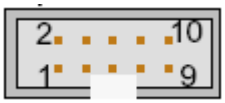

Figure 4.3 JTAG Connector Pin Assignment: Top View Male

Table 4.5 JTAG Connector Pin Assignment

Signal	Description
TRST*	JTAG TAP reset. When asserted low, the TAP controller is asynchronously forced to enter a reset state, which in turn asynchronously initializes other test logic. An unterminated TRST_l produces the same result as if it were driven high. The TAP controller must be reset before the chip can function in normal operating mode.
Cable Detection	Open collector input. Not used in the PEXMUX.
TDO	JTAG serial data out. Signal TDO is the serial output through which test instructions and data from the test logic.
TDI	JTAG serial data in. Signal TDI is the serial input through which JTAG instructions and test data enter the JTAG interface. The new data on TDI is sampled on the rising edge of TCK. An unterminated TDI produces the same result as if TDI were driven high.
TMS	JTAG test mode select. Signal TMS causes state transitions in the test access port (TAP) controller. An un-driven TMS has the same result as if it were driven high.
TCK	JTAG boundary–scan clock. Signal TCK is the clock controlling the JTAG logic.

Table 4.6 IPSO JTAG Signal Description

4.7 Power Requirements

Pin Number	Signal			
1	3.3 V			
2	3.3 V			
3	GND			
4	GND			

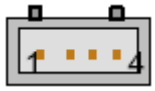

Figure 4.4 ST2 Power Connector Pin Assignment: Top View Male

Table 4.7 ST2 Power Connector Pin Assignment

Part Number	Assembly	+3.3 V
PEXMUX 16 Unit H12502	2XPEXMUX Board CPU-A Board	2 Amp

Table 4.8 Part Number for PEXMUX 16 Unit

4.8 Pin Allocation for the LVDS Connectors

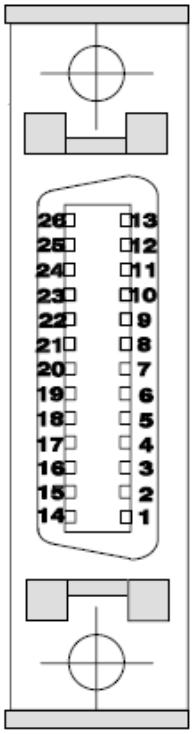

Figure 4.5 Pin Assignment for the 48-Bit LVDS Connector at the PCB

Function	Wire Type	Transmitter Signal	Receiver Signal	Pin Nr.
Signal: Differential pair of the received serial transmit clock connected to the corresponding inputs of the transmitter.	twisted and shielded	TxCLK_P	RxCLK_P	6
		TxCLK_M	RxCLK_M	18
Shield: Common drain wire of all separate shields, connected to CHASSIS.		LVDS Gnd		26
Signal: Differential pair of the received serial data stream connected to the corresponding inputs of the transmitter.	twisted and shielded	TxIN_P0	RxIN_P0	3
		TxIN_M0	RxIN_M0	15
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P1	RxIN_P1	4
		TxIN_M1	RxIN_M1	16
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P2	RxIN_P2	5
		TxIN_M2	RxIN_M2	17
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P3	RxIN_P3	9
		TxIN_M3	RxIN_M3	21
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P4	RxIN_P4	10
		TxIN_M4	RxIN_M4	22
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P5	RxIN_P5	11
		TxIN_M5	RxIN_M5	23
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P6	RxIN_P6	12
		TxIN_M6	RxIN_M6	24
Shield		LVDS Gnd		26
Signal	twisted and shielded	TxIN_P7	RxIN_P7	13
		TxIN_M7	RxIN_M7	25
Shield		LVDS Gnd		26
USB signal pair, left open.	twisted and shielded	USB+		1
		USB-		14
Shield of the USB signal pair, connected to CHASSIS		USB Gnd		2
Signal: Connected to Bit1 of register „chan-conf“ on F- and G-Controller.	individual	CHANNEL_DETECT0		7
Signal: Connected to Bit0 of register „chan-conf“ on F- and G-Controller.	individual	CHANNEL_DETECT1		20
VCC of USB power, left open.	individual	USB pwr		19

Table 4.9 LVDS Connector: Cable and Pin Assignment

GND of USB power, connected to GND.	individual	USB Gnd	8
Common shield of the entire bundle.	shield	CHASSIS	body

Table 4.9 LVDS Connector: Cable and Pin Assignment

4.8.1 CHASSIS

The CHASSIS is a separate plane in the PCB layer stack. This plane is stacked close by the ground plane, giving a very tight capacitive (only capacitive) and low inductance coupling to GND. The chassis plane is screwed together with the external chassis along the front edge near the connectors and the line drivers.

This solution reduces the digital noise at that point and the noise which is picked up by the driver and carried to the outside. In addition this avoids parasitic current through the GND plane which could be caused by potential differences of the remote device.

5 Transport, Packaging and Storage

The PEXMUX units contain sensitive and damageable parts and assemblies that must be handled with care.

i Installation and initial commissioning must only be carried out by employees of the manufacturer or persons authorised by the manufacturer.

Nevertheless, it may happen in the course of installation and further use that the owner‘s operating or maintenance personnel may be entrusted with handling pack units. In this regard, it is vital to observe the instructions listed below.

5.1 Inspection at Delivery

When the PEXMUX is delivered it has to be inspected for completeness and transport damage.

Proceed as follows in the event of externally apparent transport damage:

- Do not accept the delivery, or only accept it subject to reservation.
- Note the extent of the damage on the transport documentation or the shipper‘s delivery note.
- All the shipping cartons should be stored for further investigation.
- Initiate complaint procedures immediately.

5.2 Packaging

The individual packages are packaged in accordance with anticipated transport conditions. Only environmentally friendly materials have been used in the packaging.

The packaging is intended to protect the individual components from transport damage, corrosion and other damage prior to assembly. Therefore do not destroy the packaging and only remove it shortly before assembly.

5.2.1 Handling Packaging Materials

Dispose of packaging material in accordance with the relevant applicable legal requirements and local regulations.

5.3 Storage

When the PEXMUX is not installed immediately, it has to be stored in the original packing under the following conditions:

- Do not store outdoors.
- Store in dry and dust-free conditions.
- Do not expose to aggressive media.
- Protect against direct sunlight.
- Avoid mechanical shocks.
- Storage temperature: 5°C to 40°C.
- Relative humidity: Maximum of 80% for temperatures up to 31°C, linearly decreasing to 50% at a temperature of 40°C.
- If stored for longer than 3 months, regularly check the general condition of all parts and the packaging. If necessary, top-up or replace preservatives.

6 Installation and Initial Commissioning

⚠ WARNING

Danger to life from incorrect installation!

Errors during installation may result in potentially hazardous situations and may cause significant damage to property.

- ▶ Installation must only be carried out according to the instructions provided in this manual.

6.1 Safety

Improper initial commissioning

⚠ WARNING

Danger of injury from improper initial commissioning!

Improper initial commissioning can result in serious injury and significant damage to property.

- ▶ Before the initial commissioning, ensure that all installation work has been carried out and completed in accordance with the information and instructions in this manual.

Electrical system

⚠ WARNING

Danger to life or material damage from electric power!

Contact with live parts may prove fatal. When switched on, electric components are under high voltage.

- ► Switch off the power supply before starting work and make sure that it cannot be switched on again.

Securing to prevent restart

⚠ WARNING

Danger to life from an un authorised restart!

In the event of an un authorised restart of the power supply during installation, there is a danger of serious injuries or death for persons in the danger zone.

- ► Switch off all power supplies before starting work and make sure they cannot be switched on again.

6.2 Installation

All the requirements concerning the environment described in the "Operating Environment" on page 12 have to be met before the unit can be installed.

To reduce the risk of electric shock and malfunctioning, install these devices in a temperature and humidity controlled indoor area free of conductive contaminants. The power supply cord is intended to serve as the disconnect device. The socket outlet should be near the equipment and easily accessible.

6.2.1 External Connections

The following cables have to be connected before the IPSO can be put into operation:

1. Connect the LAN (Ethernet) RJ45 connector to the Ethernet connector on the HWIDS unit.
2. Connect the LVDS Input (TX-Controller) to an IPSO FCTRL channel. With the PEXMUX 16, connect the second input to a second IPSO FCTRL channel.
3. Connect the LVDS Outputs (up to 8 for the PEXMUX 8, up to 16 for the PEXMUX 16) to the appropriate SGU's.

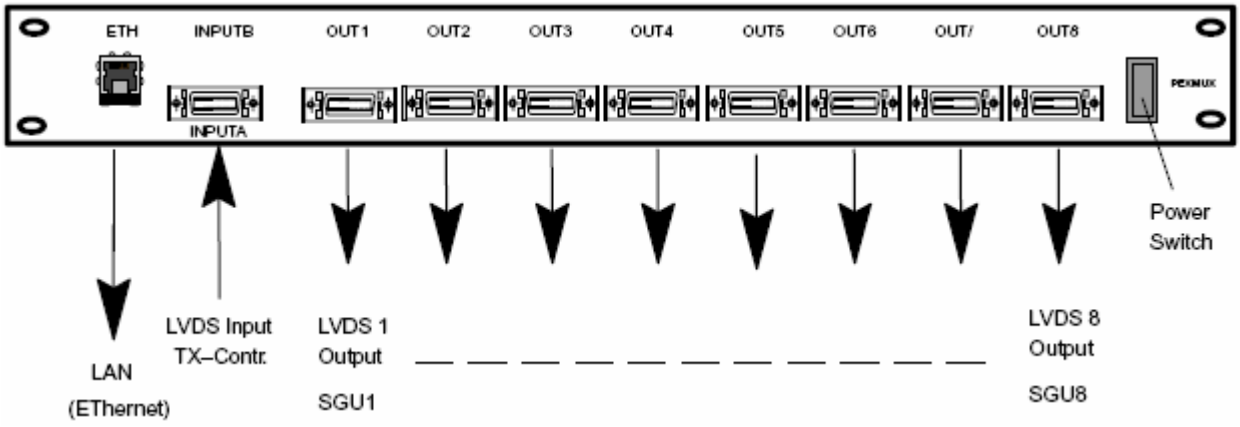

Figure 6.1 External Connections for the PEXMUX8 Unit

The Ethernet link is used to read the BIS configuration of the unit via the WINBIS and SOAP interface program. The BIS information is stored on the CPU–A board and contains a list of 4 entries:

- PEXMUX Board 1,
- PEXMUX Board 2,
- CPU–A board,
- PEXMUX Unit.

For a detailed description of the operation refer to the PEXMUX_doc_20080813.

To prevent the sending of corrupted data after power up the PEXMUX Unit should be first powered up after the IPSO AQS Unit is ready and connected.

The IPSO Test Program has special commands used to test the correct function of the PEXMUX unit. In this case the LVDS input is connected to the appropriate FCTRL channel and the output is connected to the IPSO RCTRL channel. The PEXMUX outputs are sequentially tested from OUT1 to OUT8.

7 Operating Instructions

The only operations permitted by the user are:

- Connecting the data interface cables (see "Installation" on page 26).
- Switching on the unit using the power switch (see Figure 6.1 for location of the switch).

Once the unit is switched on there are no further operating procedures for the PEXMUX unit.

During operation the user must take great care in following the safety related information provided in this manual.

⚠ WARNING

Danger of injury if personnel are insufficiently qualified.

If unqualified personnel perform work on the unit or are in the units danger zone, hazards may arise which can cause serious injury and substantial damage to property:

► Except for CRU's, all operations inside the PEXMUX must be carried out by a Bruker service engineer or an authorized agent.

7.1 Operator Protection

The electronic circuitry of the PEXMUX operates with low and safe voltages, except for the power supply and its mains connection. Nevertheless, any electrical equipment may become a source of danger under extreme conditions:

⚠ WARNING

Risk to life due to extreme weather conditions.

During a lighting storm contact with cables may be life-threatening:

► Ensure that the electrical power source is properly grounded.

► Do not loosen, connect or touch any cables during a lightning storm.

⚠ WARNING

Material or personnel damage from worn or damaged parts.

Damaged or worn parts may result if one or the following circumstances occurs:

- The power cord, power plug or power supply are cracked, brittle or damaged.

⚠ WARNING

Electrical hazard from electrical shock.

A life threatening shock may result when the housing is open during operation.

- Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
- Be sure that the power supply cannot be reconnected without notice.
- The housing must be closed during operation.

7.2 Unit Protection

NOTICE

Material damage hazard from electrostatic discharge (ESD).

Friction between material being conveyed may result in the buildup of electrostatic potential. Contact with the uncovered metal of the printed circuit board (PCB) may result in material damage.

- Potential equalisation must be ensured before making contact with parts.
- Where appropriate use ESD flooring and wear ESD shoes.

NOTICE

Material damage hazard from incorrect cable connections.

Incorrect cable connections or disconnecting cables while the unit is under operation may result in material damage.

- Do not connect a transmitter to the LVDS OUT connectors (OUT1 - OUT8) of the PEXMUX unit!
- A LVDS cable should never be removed from or connected to an operating controller. Corrupted data may be sampled as valid.

8 Maintenance and Cleaning

8.1 Safety

⚠ WARNING

Danger to life or material damage from electric power!

Contact with live parts may prove fatal. When switched on, electric components are under high voltage.

- ▶ Switch off the power supply before starting work and make sure that it cannot be switched on again.

⚠ WARNING

Danger to life from an unauthorised restart!

In the event of an unauthorised restart of the power supply during maintenance, there is a danger of serious injuries or death for persons in the danger zone.

- ▶ Switch off all power supplies before starting work and make sure they cannot be switched on again.

⚠ WARNING

Danger of injury from improperly executed maintenance work!

Improper maintenance may result in serious injury and significant damage to property.

- ▶ Ensure sufficient assembly space before starting work.
- ▶ Pay attention to orderliness and cleanliness in the assembly location! Loosely stacked or scattered components and tools could cause accidents.
- ▶ If components have been removed, pay attention to correct assembly, refit all fixing elements and comply with bolt tightening torques.

Before the restart, ensure that:

- ▶ All maintenance work has been carried out and completed in accordance with the specifications and instructions in the manual.
- ▶ No persons are in the danger zone.
- ▶ All covers and safety devices are installed and functioning properly.

8.1.1 Environmental protection

Observe the following environmental protection instructions during maintenance work:

- In respect to all lubrication points supplied manually with lubricant, remove any escaping, used or surplus grease and dispose of it in accordance with applicable local regulations.
- Catch replaced oils in suitable containers and dispose of in accordance with applicable local regulations.

8.2 Maintenance

The PEXMUX unit can be expected to have a long and trouble-free life with a minimum of preventive maintenance. Environmental issues are essential in determining the reliability. The temperature and humidity have to be within specifications. All servicing must be performed by qualified service personnel.

Before maintenance, repair or shipment, the unit must be completely switched off and unplugged or disconnected and dismounted from its rack.

8.3 Cleaning

Cleaning the surface of the enclosure and/or front panel can be carried out by the customer, if the following instructions are adhered to.

1. Switch off the equipment and unplug the power cable and all data cables.
2. Clean up the surface with a dry or damp cloth.
3. Let the enclosure completely dry before installing
4. Connect all cables and power up.

8.4 Service Requests

In case of questions or problems, please contact your nearest Bruker office or representative. See "Contact" on page 35 for details

Maintenance and Cleaning

9 Contact

Manufacturer:
Bruker BioSpin NMR
am Silberstreifen
D-76287 Rheinstetten
Germany
Phone: +49 721-5161-0
http://www.bruker-biospin.com

NMR Hotlines

Contact our NMR service centers.

Bruker BioSpin NMR provide dedicated hotlines and service centers, so that our specialists can respond as quickly as possible to all your service requests, applications questions, software or technical needs.

Please select the NMR service center or hotline you wish to contact from our list available at:

http://www.bruker-biospin.com/hotlines_nmr.html

Contact

Appendix A

A.1 Warning Signs

A.2 Figures

A.3 Tables

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Bruker BioSpin Group

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