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Technical description

CPCI-7500

4-port serial interface

Edition: 04.05 - 03/2022

Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current state before printing.

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Warning!

The following risks result from the improper implementation of the board and from use contrary to the regulations:



Personal injury



Damage to the board, the PC and peripherals



Pollution of the environment.

- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!
If this leaflet is not enclosed with the documentation,
please contact us and ask for it.
- Observe the instructions of this manual!
Make sure that you do not forget or skip any step!
We are not liable for damages resulting from the
wrong use of the board.
- Pay attention to the following symbols:



NOTICE!

Designates hints and other useful information.



NOTICE!

Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or
peripherals may be **destroyed**.



WARNING!

Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC
and/or peripherals may be **destroyed** and persons
may be **endangered**.

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1 DEFINITION OF APPLICATION

1.1 Intended use

The board **CPCI-7500** must be inserted in a CompactPCI/PXI computer with CompactPCI slots which is used as electrical equipment for measurement, control and laboratory pursuant to the standard DIN EN IEC 61010-1.

The used CompactPCI/PXI computer must fulfil the requirements of DIN EN IEC 62368-1 and DIN EN 55032 or IEC/CISPR 32 and DIN EN 55024 or IEC/CISPR 24.

The use of the board **CPCI-7500** in combination with external screw terminal panels requires correct installation according to the standard DIN EN IEC 60439-1 (Low-voltage switchgear and controlgear assemblies).

1.2 Usage restrictions

The **CPCI-7500** board must not be used as a safety-related part (SRP).

The board **CPCI-7500** must not be used for safety-related functions, such as emergency stop functions.

The **CPCI-7500** board must not be used in potentially explosive atmospheres.

The **CPCI-7500** board must not be used as electrical equipment according to the Low Voltage Directive 2014/35/EU.

1.3 Limits of use

All safety information and the instructions in the manual must be followed to ensure proper intended use.

Uses of the board beyond these specifications are considered as improper use. The manufacturer is not liable for damages resulting from improper use.

The board must remain in its anti-static packaging until it is installed.

Please do not delete the identification numbers of the board or the warranty claim will be invalid.

1.4 General description

The board **CPCI-7500** provides industrial PCs with four asynchronous serial interfaces for the communication with external devices.

Table 1-1: Version and options

Board	Interface
CPCI-7500	4-port serial
Options	Features
URS-7500-6U	6U front panel for mounting in 6U housing
Quarz	Transfer rate up to 1 Mbaud

In terms of electromagnetic compatibility (EMC), the connection cables have the following properties:

- metallised connector housing
- shielded cable
- cable shield folded back over insulation and firmly screwed on both sides to the connector housing.

The transmission standard of the respective interface depends on the fitted MX module.

Table 1-2: Plug-in modules and their transmission standards

Plug-in module ¹	Transmission standard	Maximum Baud rate ²	Optical isolation	Interface setting	Distance between transmitter and receiver ³
MX232-G	RS232	115.2 kbauds	1 kV	-	30 m
MX422-G MX422-PEP (RTS/CTS als RS422)	RS422	115.2 kbauds	1 kV	-	1.2 km
MX485-G	RS485	115.2 kbauds	1 kV	Automatic transmitter control	1.2 km
MXTTY	TTY (20 mA current loop)	115.2 kbauds	1 kV	Standby current on transmit and receive channel	1 km

¹ Plug-in module **MXxxx-G**: The -G suffix stands for optical isolation. The **MXTTY** module is always optically isolated.

² A transfer rate up to 1 Mbaud is possible using an equipment option (Quarz option).

³ The indicated maximum lengths apply to normal interface cables (shielded control lead, 0.14 mm²). The length is also limited by the number of users, impedance, line capacity and transfer rate.

2 USER

2.1 Qualification

Only persons trained in electronics are entitled to perform the following works:

- Installation
- Commissioning
- Use
- Maintenance.

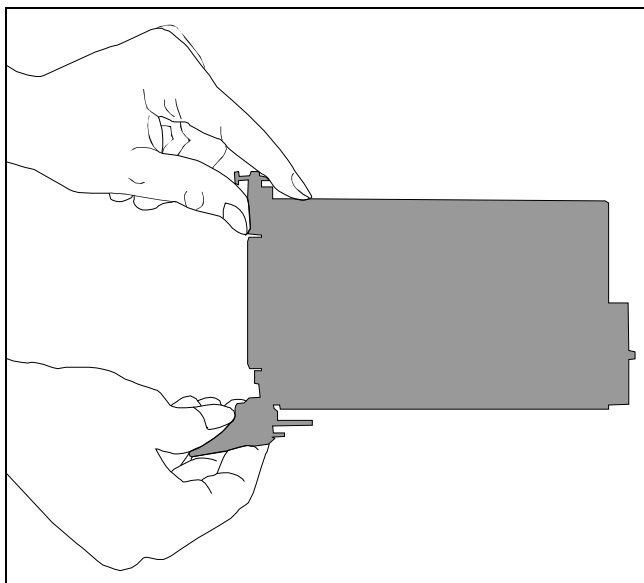
2.2 Country-specific regulations

Consider the country-specific regulations about

- the prevention of accidents
- electrical and mechanical installations
- Electromagnetic compatibility (EMC).

3 HANDLING OF THE BOARD

Fig. 3-1: Correct handling



Hold the board cautiously at the outer end and at the front panel.
Do not touch the surface of the board!

4 TECHNICAL DATA

4.1 Electromagnetic compatibility (EMC)

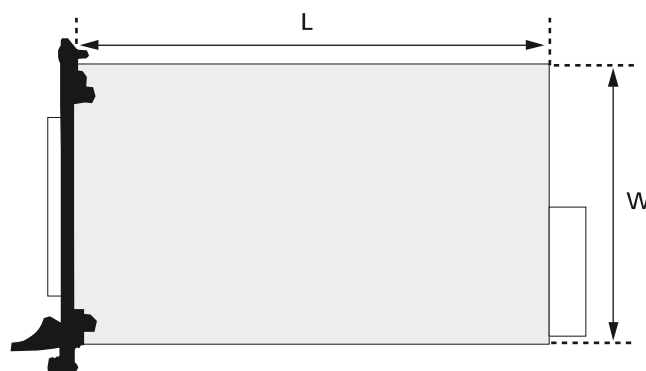
The board **CPCI-7500** is suited for installation in CompactPCI/PXI computers which comply with the European EMC directive.

The board **CPCI-7500** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the standard DIN EN IEC 61326-1. The limit values as set out by the European EMC directive for an industrial environment are complied with.

The respective EMC test report is available on request.

4.2 Physical set-up of the board

Dimensions:



Dimensions (L x W):..... 160 x 100 mm

Weight: approx. 200 g

Installation in: 32-/64-bit CompactPCI slot
(3.3 V / 5 V signal voltage)

Connection of the peripherals:..... 37-pin D-Sub male connector

Connection cables for the CPCI-7500¹:

ST074:

37-pin D-Sub female connector to 4 x 25-pin D-Sub male connector

ST075:

37-pin D-Sub female connector to 4 x 9-pin D-Sub male connector



NOTICE!

The connection lines must be installed in such a way that they are protected against mechanical loads.

¹ Not included in standard delivery. Please order separately!

4.3 Limit values

Max. height: 2000 m
 Operating temperature: 0 to 60 °C (with forced ventilation)
 Storage temperature: -25 to 70 °C
 Relative humidity at
 indoor installation: 50 % at +40 °C
 80 % at +31 °C

Minimum PC requirements:

Bus speed: ≤ 33 MHz
 Operating system: Windows 10, Windows 7, Linux

Energy requirements:

- Operating voltage of the PC: 5 V ± 5 %
 - Current consumption (without load): 55 mA ± 10 %

Add to this data the current consumption of the used modules according to the following table:

	MXxxx-G
RS232	86 mA
RS422	46 mA
RS485	58 mA
20 mA¹	-
MX422-PEP²	66 mA

4.3.1 RS232

CCITT-recommendation: V.24
 US standard EIA: RS232

MX232-G

Max. Baud rate: 115.2 kbauds/kbps
 Quartz option: up to 1 Mbaud
 ESD protection 15 kV
 Creeping distance: 3.2 mm
 Test voltage: 1000 VAC

¹ MXTTY module with optical isolation

² With software handshake (RTS CTS version)

4.3.2 RS422, RS485

CCITT recommendation: V.11
US standard EIA: RS422, RS485

MX422-G, MX485-G

Max. Baud rate: 115.2 kbauds/kbps
Quarz option: up to 1 Mbaud
ESD protection 15 kV
Creeping distance: 3.2 mm
Test voltage: 1000 VAC
Short-circuit protection

4.3.3 20mA constant current loop (MXTTY)

Max. Baud rate: 19.2 kbauds/kbps
TVS diodes: 400 W absorption power
Creeping distance: 3.2 mm
Test voltage: 1000 VAC
Load: 500 Ω
Reverse polarity protection



NOTICE!

Please ensure that the quartz frequency is correctly set in the device manager of your operating system (see Chapter 8).
The 1 Mbaud rate can only be programmed with the device drivers provided for this.

5 INSTALLATION OF THE BOARD

The interrupt line and the base address of the board are allocated through software by the BIOS of the PC system. Therefore, no settings are required before inserting the board.



Risk of injury!

Be sure to follow the safety precautions!

Improper use of the board may lead to property damage and personal injury.

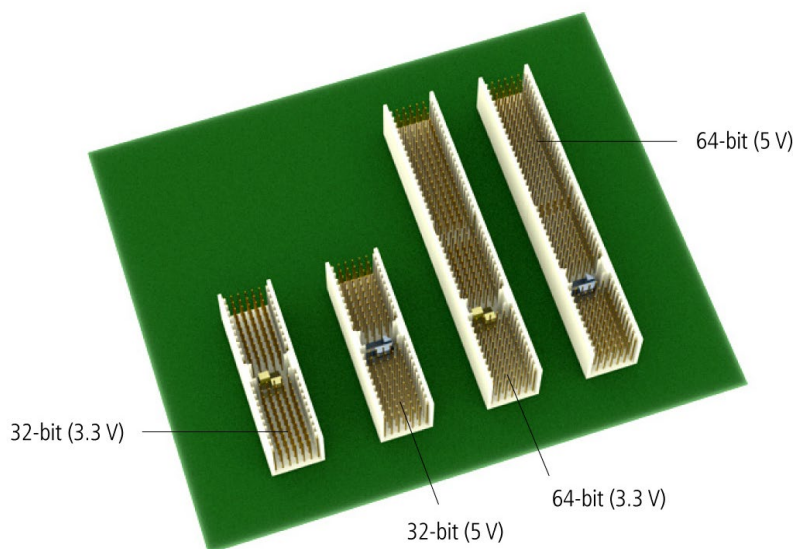
5.1 Opening the system

- ◆ Switch off your CompactPCI system and all the units connected to it.
- ◆ Pull the mains plug of the CompactPCI system from the socket.
- ◆ Remove the front cover from a free CompactPCI slot.

5.2 Selecting a free slot

- ◆ Select a free 32-/64-bit CPCI slot (3.3 V or 5 V) for the board.

Fig. 5-1: Slot types



- ◆ Provide for potential equalisation.
- ◆ Take the board out of its protective packaging.

5.3 Replacing the MX modules



NOTICE!

If an MX module has to be replaced, we recommend you to send the board back to us.

If you would like to replace the MX module yourself:

- Respect the combination options according to the intended use!
- Follow the safety precautions!
- Remove/fit the MX module carefully according to the following figures:

Fig. 5-2: Removing the MX module

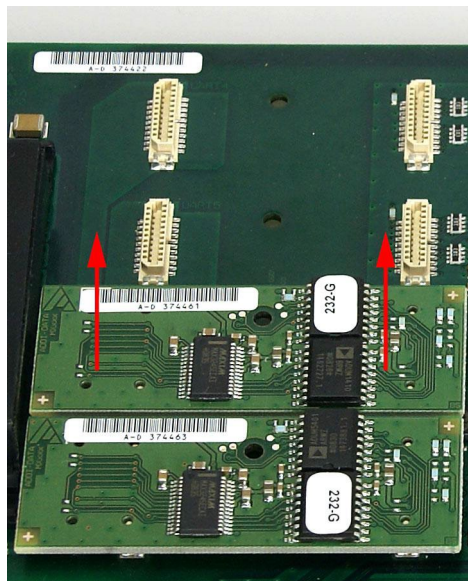
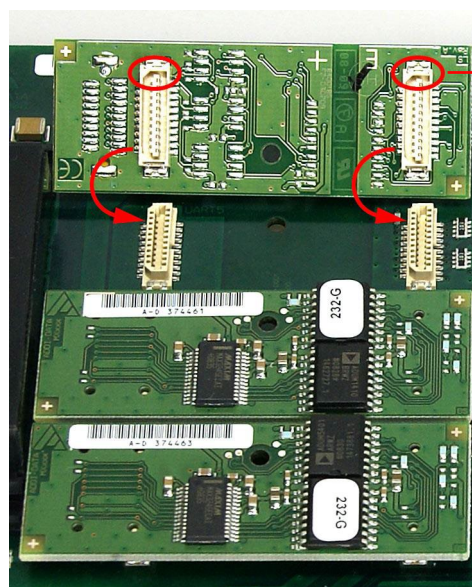


Fig. 5-3: Fitting the MX module

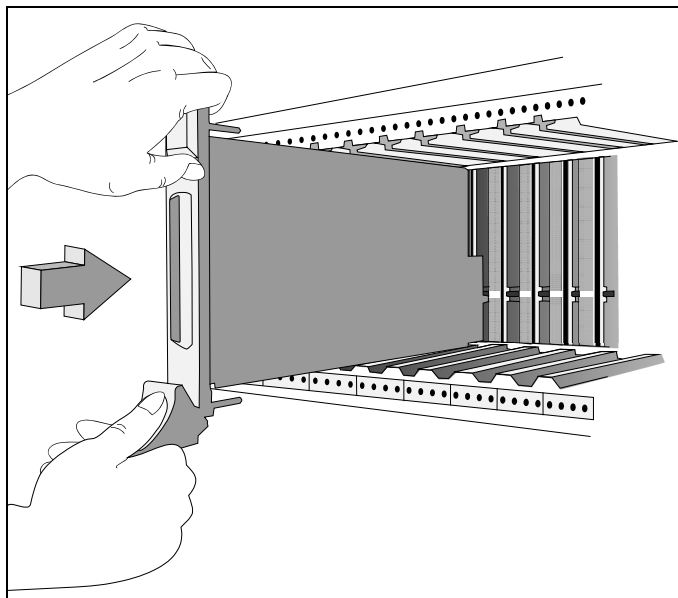


Wrong
mounting
protection

5.4 Inserting the board

- ◆ Insert the board into the guiding rails of the rack and push it forward to the rear of the housing. In order to plug it in, a slight resistance has to be overcome.

Fig. 5-4: Inserting the board



- ◆ If there is a screw at the front panel of the board, fasten the board at the upper part of the housing with it.



NOTICE!

To pull the board out of the rack, the fold-away handle (if available) at the front panel has to be pushed slightly upwards. After that, you can pull out the board.

6 SOFTWARE

6.1 Driver installation

Information on how to select and download the appropriate driver can be found in the document “Quick installation PC boards” (see PDF link).

The installation of drivers of the type “ADDI-DATA Multiarchitecture Device Drivers 32-/64-Bit for x86/AMD64” as well as the installation of the corresponding samples is described in the installation instructions (see PDF link).

6.2 Questions and updates

If you have any questions, do not hesitate to call us or to send us an e-mail:

Phone: +49 7229 1847-0

E-mail: info@addi-data.com

Manual and software download from the Internet

The latest versions of the technical manual and the standard software for the board **CPCI-7500** can be downloaded for free at: <https://drivers.addi-data.com>.



NOTICE!

Before using the board and in case of malfunction during operation, check if there is an update (manual, driver) available. Current data can be found on our website or contact us directly.

7 CONNECTING THE PERIPHERALS

7.1 Pin assignment

Fig. 7-1: 37-pin D-Sub male connector

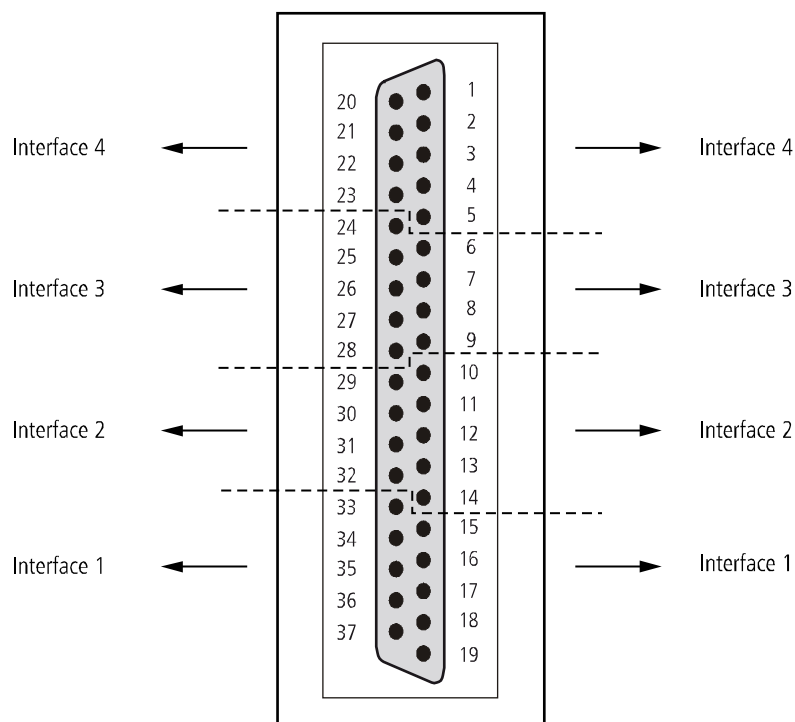


Table 7-1: Pin assignment of the 37-pin connector

RS485	RS422	Current loop	RS232	Pin	Pin	RS232	Current loop	RS422	RS485	
Tx/Rx-	RB	-RCV-CL-DATA	RI	19	37	GND	GND	GND		Port 1
		Rsource	CTS	18	36	DTR		Rab*2	Tx/Rx+	
		Tsource	RTS	17	35	TxD	+RCV-CL-DATA	RA		
120 Ω	100 Ω		DSR	16	34	RxD	-XMIT-CL-DATA	TB		
				15	33	CD	+XMIT-CL-DATA	TA		
	GND	GND	GND	14	32	RI	-RCV-CL-DATA	RB	Tx/Rx-	Port 2
Rab*2			DTR	13	31	CTS	Rsource			
Tx/Rx+	RA	+RCV-CL-DATA	TxD	12	30	RTS	Tsource			
	TB	-XMIT-CL-DATA	RxD	11	29	DSR		100 Ω	120 Ω	
	TA	+XMIT-CL-DATA	CD	10	28	GND	GND	GND		
Tx/Rx-	RB	-RCV-CL-DATA	RI	9	27	DTR		Rab*2	Tx/Rx+	Port 3
		Rsource	CTS	8	26	TxD	+RCV-CL-DATA	RA		
		Tsource	RTS	7	25	RxD	-XMIT-CL-DATA	TB		
120 Ω	100 Ω		DSR	6	24	CD	+XMIT-CL-DATA	TA		
	GND	GND	GND	5	23	RI	-RCV-CL-DATA	RB	Tx/Rx-	
Rab*2			DTR	4	22	CTS	Rsource			Port 4
Tx/Rx+	RA	+RCV-CL-DATA	TxD	3	21	RTS	Tsource			
	TB	-XMIT-CL-DATA	RxD	2	20	DSR		100 Ω	120 Ω	
	TA	+XMIT-CL-DATA	CD	1						

TA: Tx422+

RA: Rx422+

Rab: Connection to terminal resistor

TB: Tx422-

RB: Rx422-

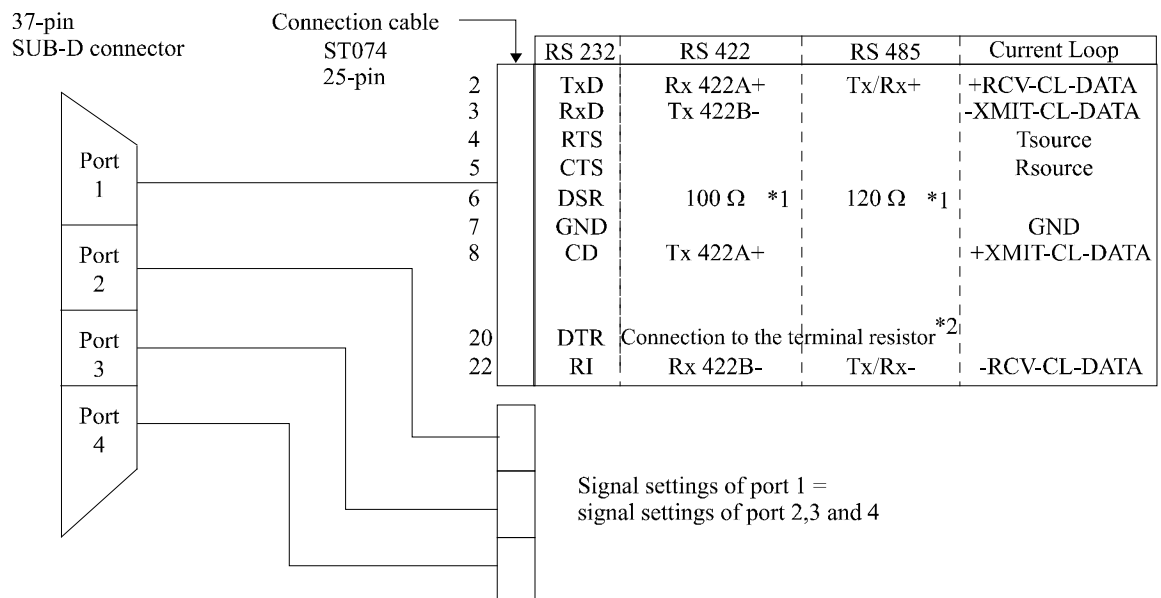
With the module **MX422-PEP**, you can use the modem control signals RTS and CTS.

Table 7-2: Pin assignment of the 37-pin connector: RS422 with handshake signals

	RS422	Pin	Pin	RS422	
Port 4	CTS+	20	1	Tx422+	Port 4
	RTS-	21	2	Tx422-	
	RTS+	22	3	Rx422+	
	Rx422-	23	4	CTS-	
Port 3	Tx422+	24	5	GND	Port 3
	Tx422-	25	6	CTS+	
	Rx422+	26	7	RTS-	
	CTS-	27	8	RTS+	
	GND	28	9	Rx422-	
Port 2	CTS+	29	10	Tx422+	Port 2
	RTS-	30	11	Tx422-	
	RTS+	31	12	Rx422+	
	Rx422-	32	13	CTS-	
Port 1	Tx422+	33	14	GND	Port 1
	Rx422-	34	15	CTS+	
	Tx422-	35	16	RTS-	
	CTS-	36	17	RTS+	
	GND	37	18	Rx422-	
			19		

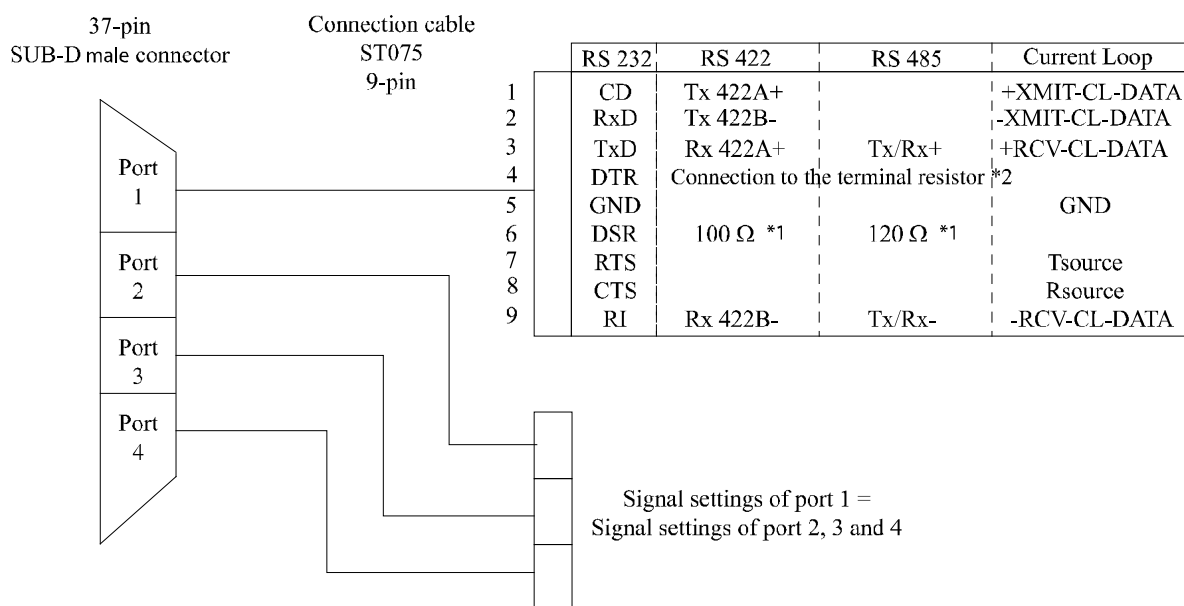
7.2 Connection cables

Fig. 7-2: Connection cable ST074 (4 x 25-pin)



* 1: Resistor integrated on the MX module

* 2: Cable connection to 100 Ω/120 Ω terminates the RS422/RS485 lines with 100 Ω/120 Ω resistor (wire bridges between pins 20 and 6).

Fig. 7-3: Connection cable ST075 (4 x 9-pin)

* 1: Resistor integrated on the MX module

* 2: Cable connection to 100 Ω/120 Ω terminates the RS422/RS485 lines with 100 Ω/120 Ω resistor (wire bridges between pins 4 and 6).

7.3 Connection examples

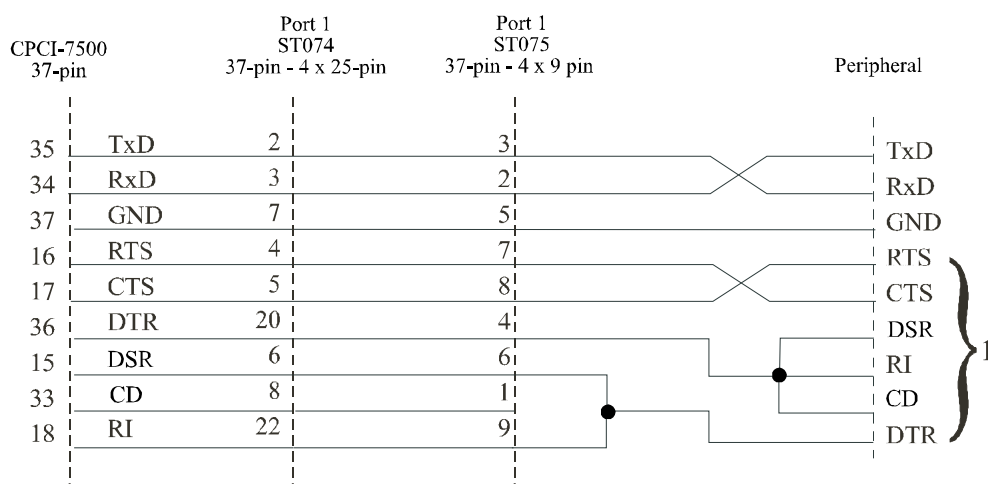
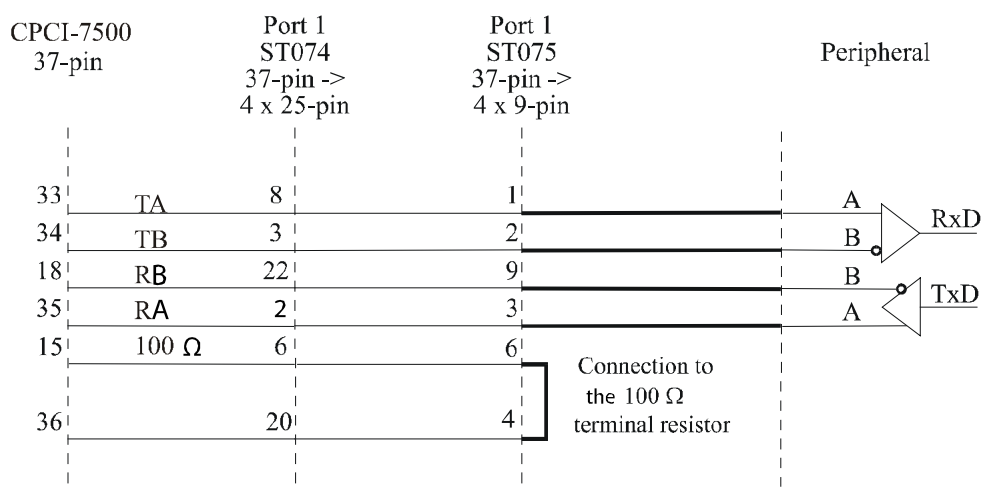
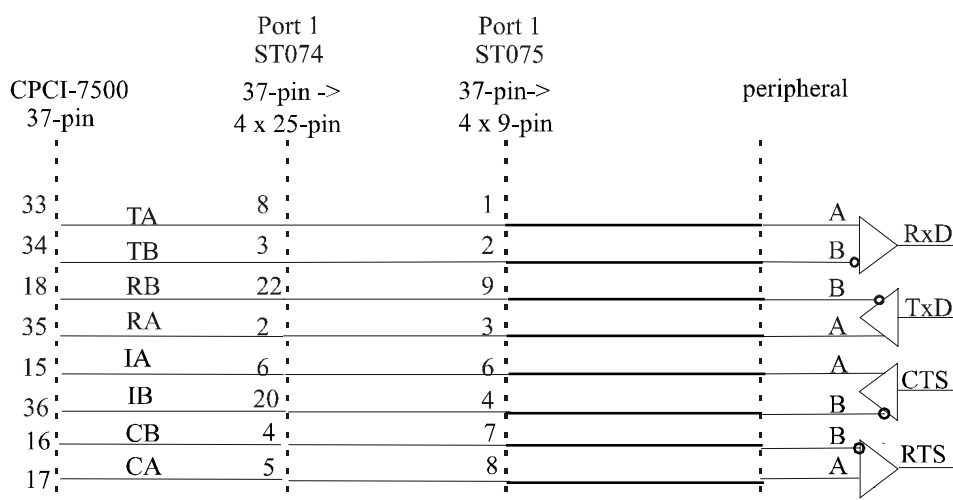
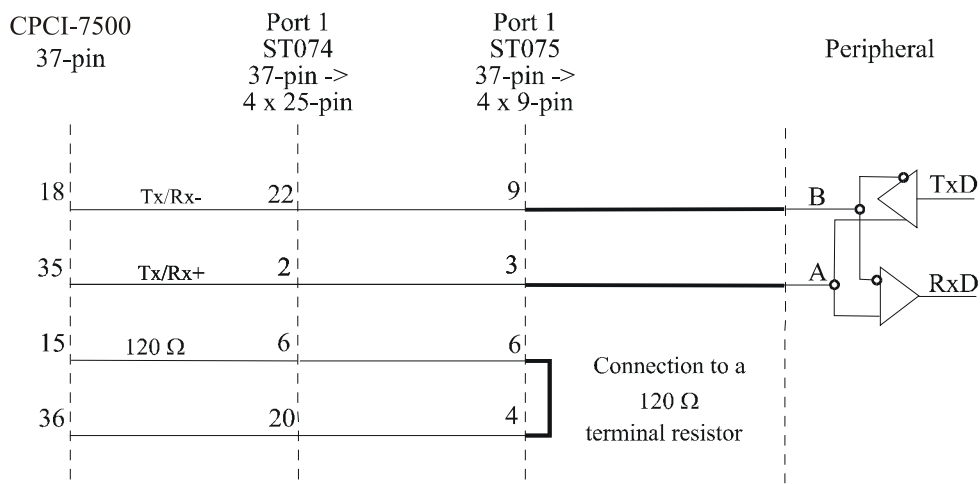
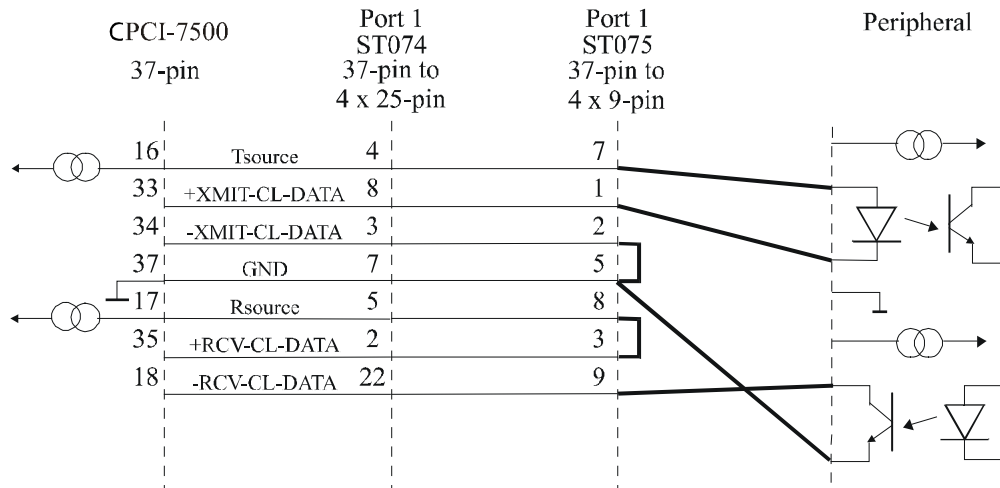
Fig. 7-4: RS232 cabling

Fig. 7-5: RS422 cabling**Fig. 7-6: RS422-PEP cabling****Fig. 7-7: RS485 cabling**

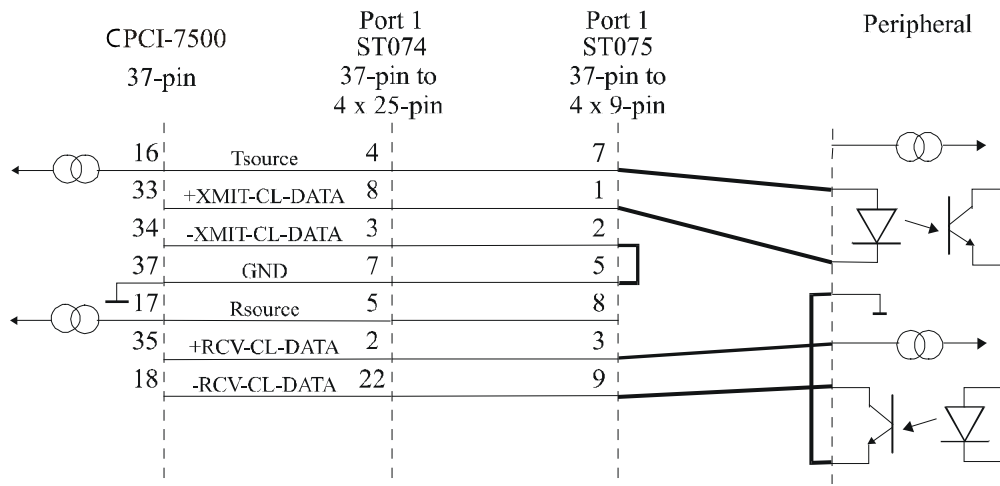
Current loop (20 mA) cabling

Active/passive: If a transmitter and a receiver communicate, one of them has to supply the necessary current. If the transmitter supplies the current, it is active. The receiver is passive. If the receiver supplies the current, it is the other way round.

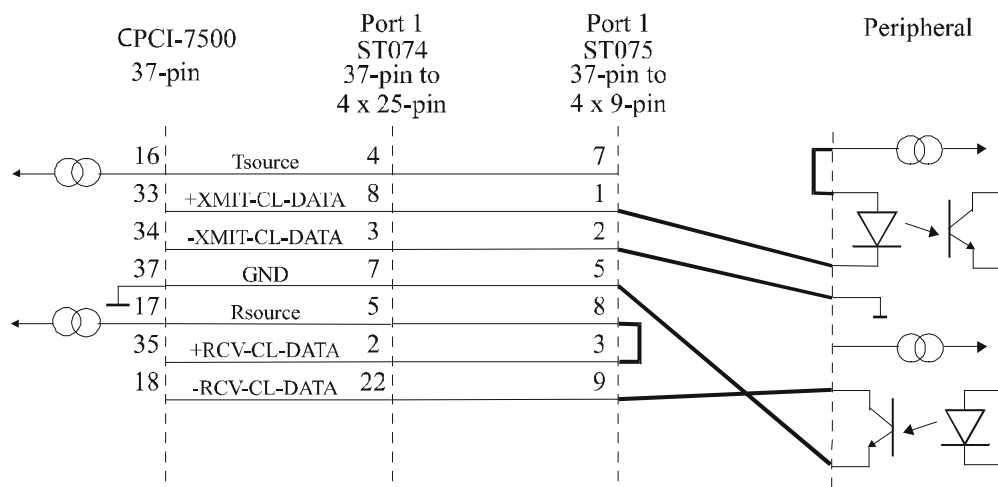
**Fig. 7-8: Active transmission/active reception
4-port serial interface**



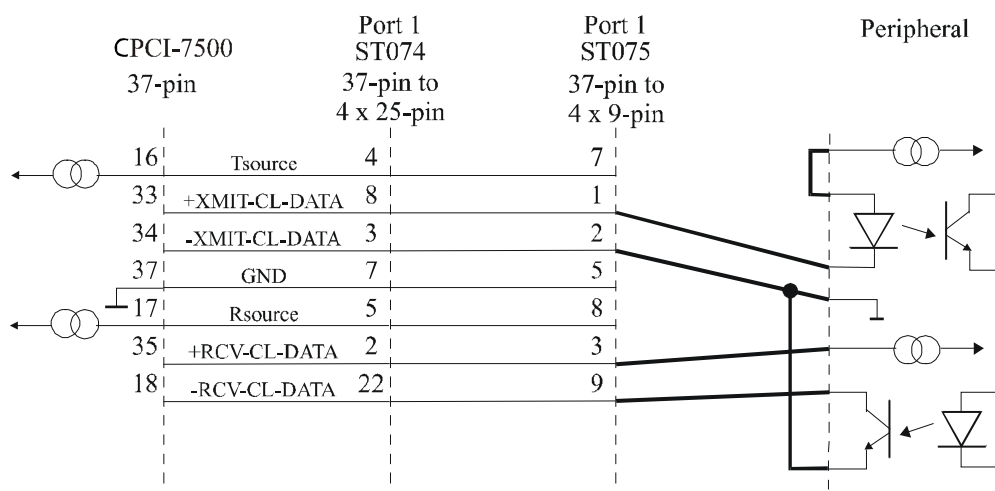
**Fig. 7-9: Active transmission/passive reception
4-port serial interface**



**Fig. 7-10: Passive transmission/active reception
4-port serial interface**



**Fig. 7-11: Passive transmission/passive reception
4-port serial interface**

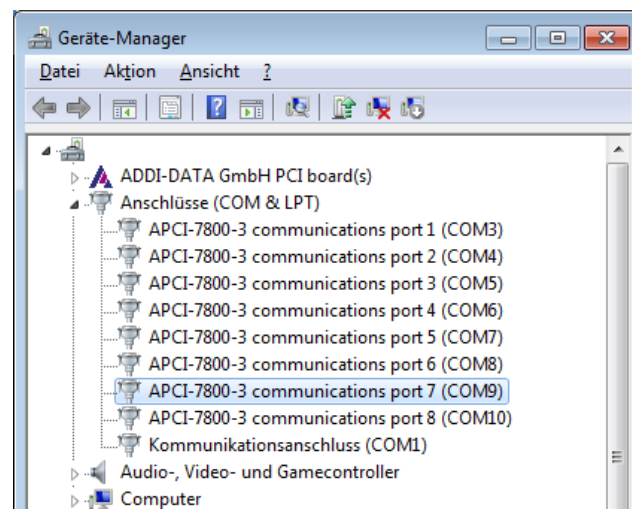


8 BOARD CONFIGURATION

After installing the driver and updating the board interfaces (see PDF link “Installation instructions”), you can configure each interface in the “Device Manager” according to your requirements.

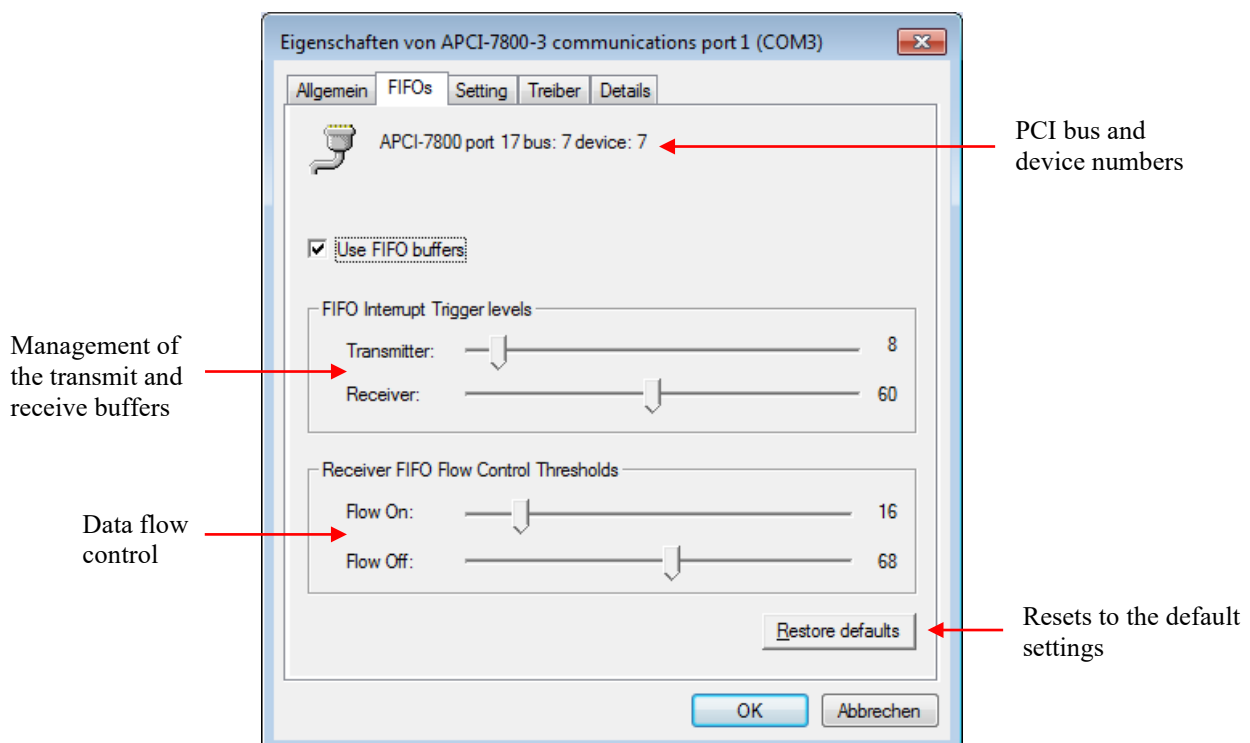
- ◆ Open the “Device Manager” and double-click on the interface to be configured (example: “APCI-7800-3 communications port 7 (COM9)”).

Fig. 8-1: Device Manager



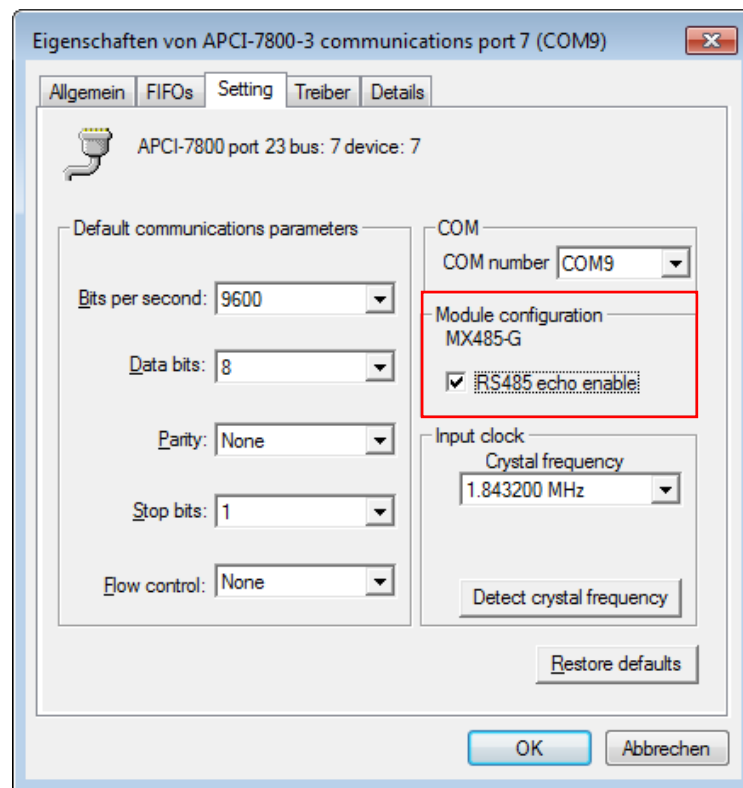
On the “FIFOs” tab, the following settings can be made (example under Windows 7):

Fig. 8-2: FIFOs



On the “Setting” tab, in the “Module configuration” section, you can adapt the transmission standard depending on the used interface.

Fig. 8-3: Settings example: RS485



RS485 echo enable: Receiver control for the RS485 half-duplex communication

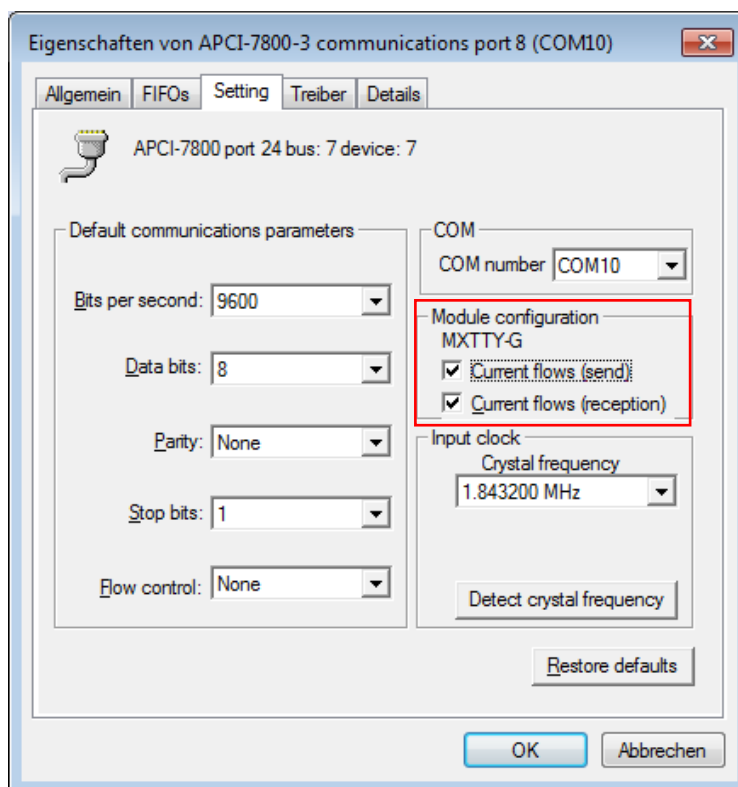
☒ Ticked:

When data is sent from the board to the peripherals, the receiver is enabled on the board.

☐ Not ticked:

When data is sent from the board to the peripherals, the receiver is disabled on the board.

Fig. 8-4: Settings example: TTY current loop

**Current flows (send):**

Definition of the current flow in the transmit current loop, i.e. the connection between the **CPCI-7500** board (transmitter) and the peripheral device (receiver) in standby state (no serial data stream)

☒ Ticked: Current flowing

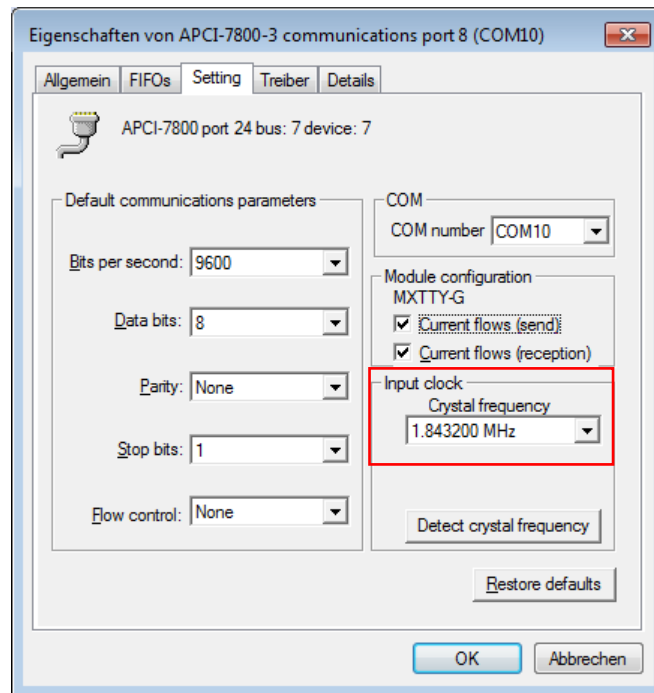
☐ Not ticked: No current flowing

Current flows (reception):

Definition of the current flow in the receive current loop, i.e. the connection between the **CPCI-7500** board (receiver) and the peripheral device (transmitter) in standby state (no serial data stream)

☒ Ticked: Current flowing

☐ Not ticked: No current flowing

Fig. 8-5: Input clock

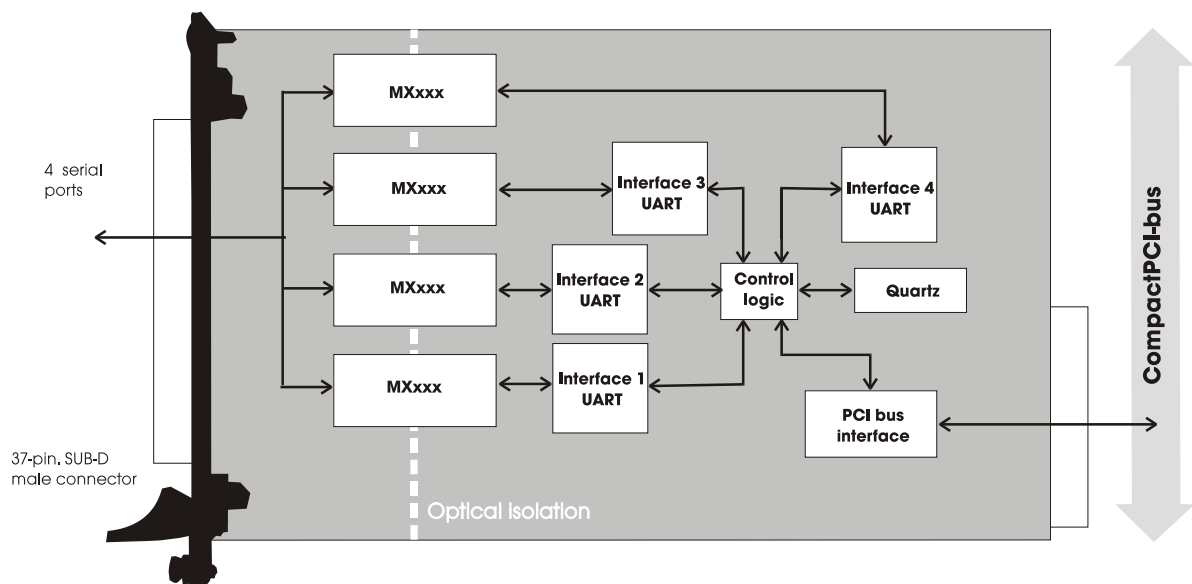
On the “Setting” tab, in the “Input clock” section, the frequency of the integrated quartz oscillator of the board is displayed. The standard PC quartz frequency is 1.8432 MHz, so that a maximum baud rate of 115200 bauds can be set.

Table 8-1: Default baud rates

Division factor DLM:DLL	Default baud rate (Input clock = 1.8432 MHz)	Default baud rate (Input clock = 160 MHz)
0x0001	115200	10000000
0x0002	57600	5000000
0x0003	38400	-
0x0004	28800	2500000
0x0006	19200	-
0x000A	11520	1000000
0x000C	9600	-
0x0010	7200	-
0x0018	4800	-
0x0030	2400	-
0x0040	1800	-
0x0060	1200	-
0x00C0	600	-
0x0180	300	-
0x0300	150	-
0x600	75	-

9 FUNCTIONS OF THE BOARD

Fig. 9-1: Block diagram of the CPCI-7500



10 TESTING THE BOARD

To test if the PC board is correctly installed, a self-test of the board can be run using a short-circuit plug and the **MTTY** test program.



NOTICE!

For the self-test of the RS485 standard, no short-circuit plug is needed.

10.1 Connecting a short-circuit plug

The short-circuit plug is used to set up a connection between the output signals (data transmission) and the input signals (data reception) in order to test the serial communication.

Fig. 10-1: Connection of the short-circuit plug (RS232)

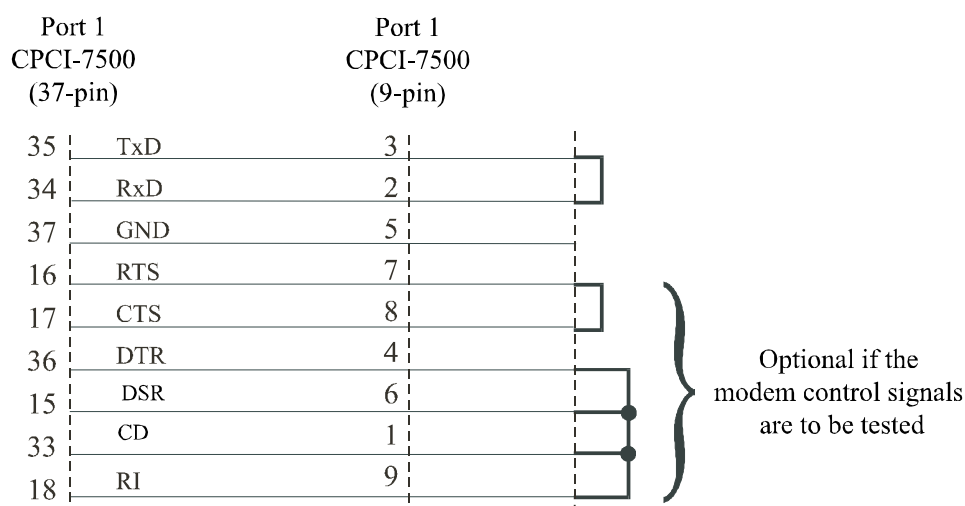


Fig. 10-2: Connection of the short-circuit plug (RS422)

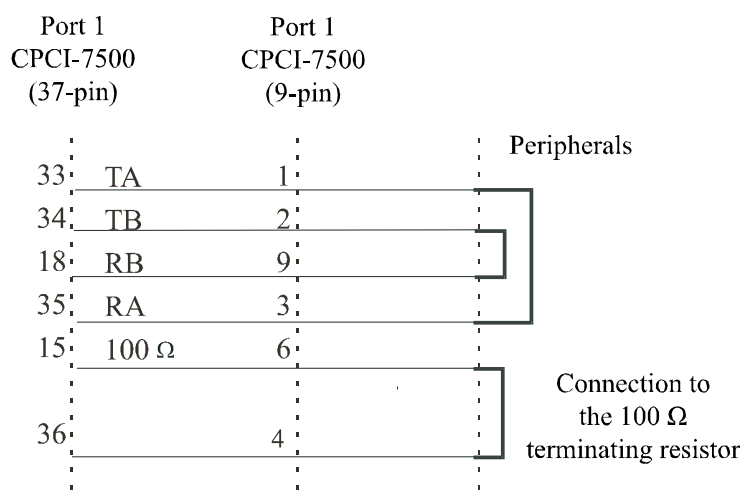


Fig. 10-3: Connection of the short-circuit plug (20 mA current loop) – active transmission / passive reception

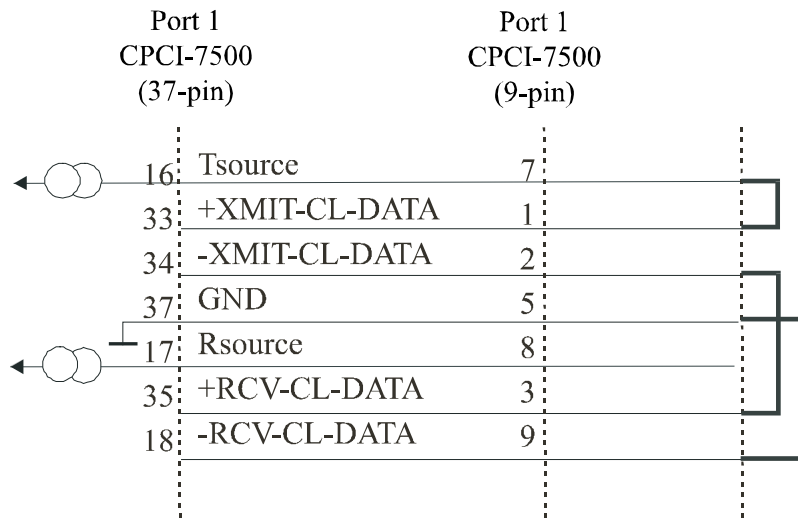
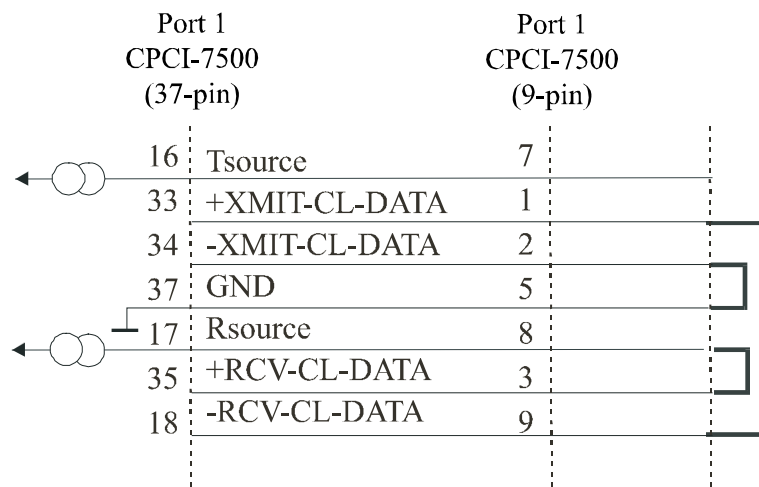


Fig. 10-4: Connection of the short-circuit plug (20 mA current loop) – passive transmission / active reception

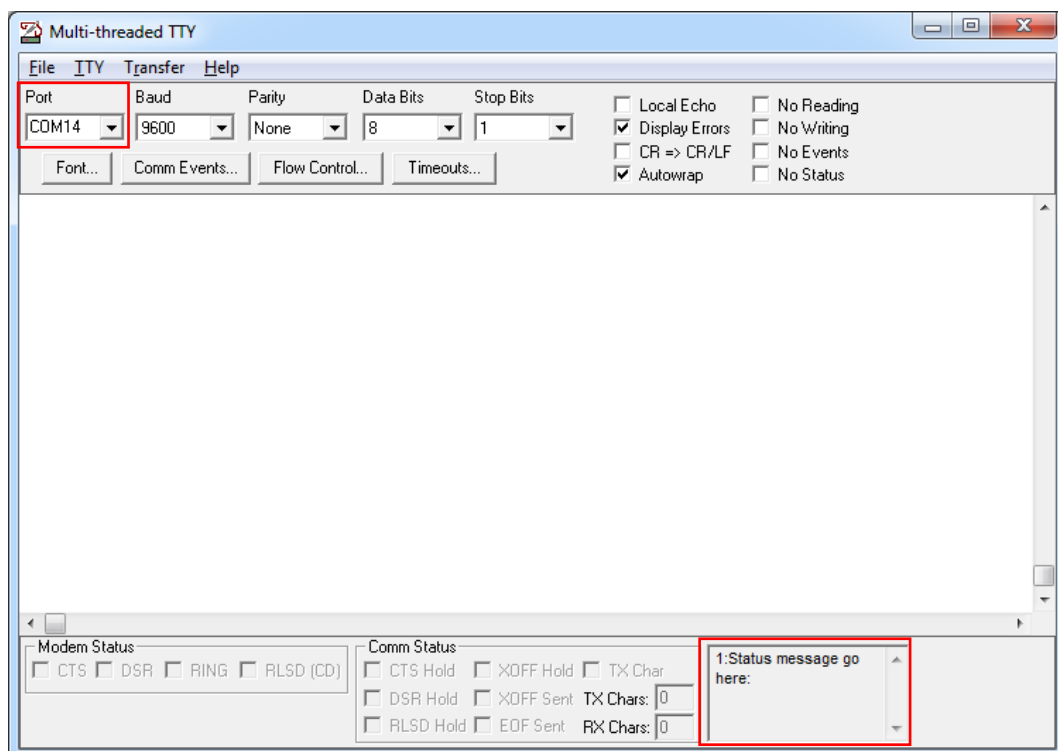


10.2 Board test with the MTTY program

The test program **MTTTY** for the ADDI-DATA serial interfaces can be downloaded from the website <https://drivers.addi-data.com>, under “Drivers / Tools (Windows)”.

- ◆ Save the downloaded .zip file in a directory of your choice and unpack it afterwards.
- ◆ Double-click on the “Mttty_255.exe” file.

Fig. 10-5: MTTY main window



Status or error messages are displayed on the bottom right of the **MTTTY** main window.

10.2.1 RS422, RS232 and TTY (20 mA current loop)

- ◆ In the **MTTTY** main window, under “Port”, select the right COM interface.
- ◆ Connect the interface via the menu item "File/Connect".

If the short-circuit plug is connected and if after pressing any key (= send data or character), a character is displayed on the screen (= receive data or character), the board works correctly.

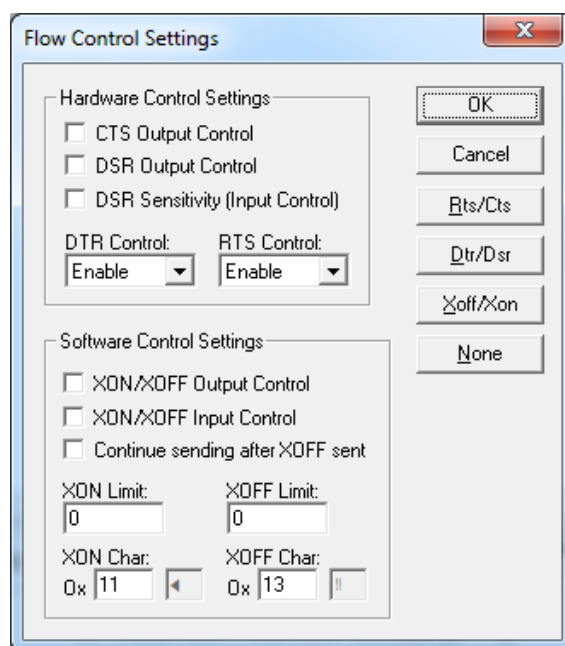
Once the port is initialised, the state of the modem control signals can be read in the “Modem Status” area of the **MTTTY** main window. If the RTS signal is set, the CTS state is indicated. For DTR, the other three fields are activated. Your settings are displayed in the “Comm Status” area of the main window.

The handshake of the modem control signals according to your application can be configured as follows:

- ◆ In the **MTTTY** main window, click on the “Flow Control...” button.

In the “Flow Control Settings” window, you can make the desired settings:

Fig. 10-6: “Flow Control Settings” window



10.2.2 RS485

This transmission standard must first be set via the “Device Manager” of the operating system (see also Chapter 8):

- ◆ Open the “Device Manager” and double-click on the interface to be configured (example: “APCI-7800-3 communications port 7 (COM9)”).
- ◆ On the “Setting” tab, in the “Module configuration” section, activate the check box “RS485 ECHO enable” and click on “OK”.
- ◆ Then start the **MTTTY** test program.
- ◆ In the **MTTTY** main window, under “Port”, select the right COM interface.
- ◆ Connect the interface via the menu item "File/Connect".

If after pressing any key (= send data or character), a character is displayed on the screen (= receive data or character), the board works correctly.

11 RETURN OR DISPOSAL

11.1 Return

If you need to return your board, you should read the following checklist before.

Checklist for returning the board:

- Specify the reason for returning your board (e.g. exchange, modification, repair), the serial number of the board, the contact person in your company including his/her telephone extension and e-mail address, as well as the mailing address for a potential new delivery. You do not have to indicate the RMA number.

Fig. 11-1: Serial number



- Note down the serial number of the board.
- Place the board in an ESD protective cover. Then pack it in a cardboard box so that it is well-protected for shipping. Send the packed board together with your details to:

ADDI-DATA GmbH
Airpark Business Center
Airport Boulevard B210
77836 Rheinmünster
Germany

- If you have any questions, do not hesitate to contact us:

Phone: +49 7229 1847-0

E-mail: info@addi-data.com

11.2 Disposal of ADDI-DATA waste equipment

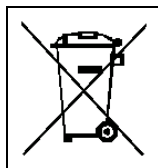
ADDI-DATA organises the disposal of ADDI-DATA products that were put on the German market after 13 August 2005.

If you want to return waste equipment, please e-mail your request to:

info@addi-data.com.

Boards that were delivered after 13 August 2005 can be recognised by the following label:

Fig. 11-2: Disposal: Label



This symbol indicates the disposal of waste electrical and electronic equipment. It is valid in the European Union and in other European countries that have a separate collection system. Products carrying this symbol must not be treated as household waste.

For more detailed information on the recycling of these products, please contact your local citizens' office, your household waste collection service, the shop where you bought this product or the distributor you purchased this product from.

If you dispose of this product correctly, you will help to prevent damage that could be caused to the environment and to human health by inappropriate disposal. The recycling of materials will help to conserve our natural resources.

Disposal in other countries than Germany

Please dispose of the product according to the country-specific regulations.

12 GLOSSARY

Table 10-1: Glossary

Term	Description
A/D converter	= <i>ADC</i> An electronic device that produces a digital output directly proportional to an analog signal output.
Acquisition	The process by which data is gathered by the computer for analysis or storage.
Baud rate	Serial communications data transfer rate; usually the number of bits-per-second.
D/A converter	= <i>DAC</i> A device that converts digital information into a corresponding analog voltage or current.
Data acquisition	Gathering information from sources such as sensors and transducers in an accurate, timely and organized manner. Modern systems convert this information to digital data which can be stored and processed by a computer.
DC voltage	= <i>Direct current voltage</i> DC voltage means that the voltage is constant respecting the time. It will always fluctuate slightly. Especially at switching on and switching off the transition behaviour is of high significance.
Disturb signal	Interferences that occur during the transfer caused by reduced bandwidth, attenuation, gain, noise, delay time etc.
Driver	A part of the software that is used to control a specific hardware device such as a data acquisition board or a printer.
Duplex	The ability to both send and receive data simultaneously over the same communications line
Gain	The factor by which an incoming signal is multiplied.
Ground	A common reference point for an electrical system.
Half duplex	Transmission in either direction, but not simultaneous
Handshaking	Exchange of predetermined signals between two devices establishing a connection. Usually, part of a communications protocol
Impedance	The reciprocal of admittance. Admittance is the complex ratio of the voltage across divided by the current flowing through a device, circuit element, or network.
Inductive loads	The voltage over the inductor is $U=L \cdot (dI/dt)$, whereas L is the inductivity and I is the current. If the current is switched on fast, the voltage over the load can become very highly for a short time.
Input impedance	The measured resistance and capacitance between the high and low inputs of a circuit.
Limit value	Exceeding the limit values, even for just a short time, can lead to the destruction or to a loss of functionality.
Low-pass filter	Transmitting all frequencies below a certain value
MUX	= <i>Multiplexer</i> An array of semiconductor or electromechanical switches with a common output used for selecting one of a number of input signals.
Noise immunity	Noise immunity is the ability of a device to work during an electromagnetic interference without reduced functions.

Term	Description
Noise suppression	The suppression of undesirable electrical interferences to a signal. Sources of noise include the ac power line, motors, generators, transformers, fluorescent lights, CRT displays, computers, electrical storms, welders, radio transmitters, and others.
Operating voltage	The operating voltage is the voltage that occurs during the continuous operation of the device. It may not exceed the continuous limit voltage. Furthermore, any negative operation situations, such as net overvoltages over one minute at switching on the device must be taken in consideration.
Optical isolation	The technique of using an optoelectric transmitter and receiver to transfer data without electrical continuity, to eliminate high-potential differences and transients.
Output voltage	The nominal voltage output reading when shaft is rotated to full range, expressed in volts DC /Vo DC)
Parameter	The parameters of a control comprise all for the control process required numeric values, e.g. for limit values and technological number.
Protective circuitry	A protective circuitry of the active part is done in order to protect the control electronic. The simplest protective circuitry is the parallel switching of a resistance.
Protective diode	At the input of the integrated MOS (Metal Oxide Semi-Conductor)-circuits used diodes, which operate at the permitted input voltages in the reverse range, but at overvoltage in the transition range and therefore protects the circuits against damage.
Resolution	The smallest significant number to which a measurement can be determined. For example, a converter with 12-bit resolution can resolve 1 part in 4096.
RS...	= <i>Recommended standard number</i>
RS232	A serial asynchronous communications standard used to connect modems, terminals and printers with serial interfaces.
RS422	Electrical characteristics of balanced-voltage digital interface circuits. Maximum connection distance of 4000 feet.
RS485	The recommended standard of the Electronic Industry Association that specifies the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems.
RTD	= <i>Resistance temperature detector</i> An electrical circuit element characterized by a positive coefficient for resistivity.
Sensor	A device that responds to physical stimuli (heat, light, sound, pressure, motion, etc.) and produces a corresponding electrical output.
Settling time	The time required, after application of a step input signal, for the output voltage to settle and remain within a specified error band around the final value. The settling time of a system includes that of all of the components of the system.
Short circuit	A short circuit of two clamps of an electric switch is when the concerning clamp voltage is zero.
Short circuit current	Short circuit current is the current between tow short-circuited clamps.

Term	Description
Synchronous	In hardware, it is an event that occurs in a fixed time relationship to another event. In software, it refers to a function that begins an operation and returns to the calling program only when the operation is complete.
Timer	The timer allows the adaptation of program processes between processor and peripheral devices. It usually contains from each other independent counters and can be programmed for several operation types over a control word register.

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