

Function Description

EnDat 2.2

APCle-1711 and CPCIs-1711

Multifunction counter board, galvanically isolated



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.

The content of this manual and the technical product data may be changed without prior notice.

ADDI-DATA GmbH reserves the right to make changes to the technical data and the materials included herein.

Warranty and liability

The user is not authorised to make changes to the product beyond the intended use, or to interfere with the product in any other way.

ADDI-DATA shall not be liable for obvious printing and phrasing errors.

In addition, ADDI DATA, if legally permissible, shall not be liable for personal injury or damage to materials caused by improper installation and/or commissioning of the product by the user or improper use; for example, if the product is operated despite faulty safety and protection devices, or if notes in the operating instructions regarding transport, storage, installation, commissioning, operation, limit values, etc. are not taken into consideration.

Liability is further excluded if the operator changes the product or the source code files without authorisation and/or if the operator is guilty of not monitoring the permanent operational capability of working parts and this has led to damage.

Copyright

This manual, which is intended for the operator and its staff only, is protected by copyright.

Duplication of the information contained in the operating instructions and of any other product information, or disclosure of this information for use by third parties, is not permitted, unless this right has been granted by the product licence issued. Non-compliance with this could lead to civil and criminal proceedings.

ADDI-DATA software product licence

Please read this licence carefully before using the standard software! The customer is only granted the right to use this software if he/she agrees with the conditions of this licence.

The software may only be used to set up the ADDI-DATA products.

Reproduction of the software is forbidden (except for back-up and for exchange of faulty data carriers). Disassembly, decompilation, decryption and reverse engineering of the software are forbidden. This licence and the software may be transferred to a third party if this party has acquired a product by purchase, has agreed to all the conditions in this licence contract and the original owner does not keep any copies of the software.

Trademarks

- ADDI-DATA, APCI-1500, MSX-Box and MSX-E are registered trademarks of ADDI-DATA GmbH.
- EnDat is a registered trademark of Dr. Johannes Heidenhain GmbH.
- Microsoft .NET, Microsoft C, Visual C++, MS-DOS, Windows XP, Windows 7, Windows 10, Windows Server 2000, Windows Server 2003, Windows Embedded and Internet Explorer are registered trademarks of Microsoft Corporation.
- Linux is a registered trademark of Linus Torvalds.
- LabVIEW, LabWindows/CVI, DASYLab, DIAdem are registered trademarks of National Instruments Corporation.
- CompactPCI is a registered trademark of PCI Industrial Computer Manufacturers Group.
- VxWorks is a registered trademark of Wind River Systems, Inc.
- RTX is a registered trademark of IntervalZero.



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**.

Contents

Warning!	3
Chapter overview	5
1 Function description	6
1.1 Tasks and features	6
1.2 Board and sensor versions	6
1.3 Block diagram	7
1.4 Used signals	8
1.5 Pin assignment: Function modules	9
1.6 Connecting the sensors	10
1.6.1 Connection to the screw terminal panel	10
1.6.2 Frequencies and cable lengths	12
1.6.3 Connection example	13
2 Standard software	14
2.1 Access to the software functions	14
2.2 Description of the software functions	14
2.2.1 Initialisation	14
2.2.2 Position value request	14
2.2.3 Position value request with additional data	14
2.2.4 Error management	15
2.2.5 Memory area selection	15
2.2.6 Reading and writing parameters	15
2.2.7 Sensor reset	15
2.2.8 Digital I/O	16
3 Appendix	17
3.1 Index	17
4 Contact and support	18

Figures

Fig. 1-1: Block diagram: "EnDat 2.2" function	7
Fig. 1-2: Pin assignment: 78-pin D-Sub female connector (4 EnDat modules)	9
Fig. 1-3: Pin assignment: 50-pin D-Sub male connector (ST1711-50 cable)	10
Fig. 1-4: Clock frequency with propagation-delay compensation	12
Fig. 1-5: Connection example: EnDat 2.2 sensors	13

Tables

Table 1-1: Used signals	8
Table 1-2: Connection of the sensors to the screw terminal panel	11
Table 1-3: Transmission frequencies	13

Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Function description including block diagram and pin assignment
2	Standard software: Information on the API software functions
3	Appendix with index
4	Contact and support address

This document solely describes the function "EnDat 2.2".

For general information on the **APCLe-1711** or **CPCIs-1711**, please read the Technical Description of these boards (see PDF link). It contains, for example, the chapter "Inserting and installing the board" that supports you in commissioning.

1 Function description

In the following chapters, the most important characteristics of the function “EnDat 2.2” are described. More detailed information on this function is to be found on the website www.endat.de as well as in the EnDat 2.2 specification, which can be ordered directly from the Heidenhain Company.

1.1 Tasks and features

EnDat 2.2 is a bidirectional synchronous serial interface for position sensors.

This interface can be used to directly read out absolute position values without reference travel, to read out parameters, to write in status and initialisation registers and to transfer additional data on the position value. The EnDat 2.2 function module also supports diagnostic value analysis such as temperature and line break as well as access to the OEM memory area. Moreover, it enables performance resource analysis.

The connection cable consists of four differential lines for clock frequency, data transfer, voltage supply (5 V) and GND connection. Data transfer is purely serial.

Features:

- 4 function modules for one board, 2 sensors for each function module
- Optical isolation of the inputs and outputs to prevent ground loops
- Serial data transfer
- 4 signal lines per channel (2 for clock, 2 for sending/receiving data)
- 3 digital inputs (24 V) and 1 freely controllable digital output (24 V) for each function module

1.2 Board and sensor versions



NOTICE!

The “EnDat 2.2” function can only be used with the standard version of the **APCLe-1711** or **CPCIs-1711**.

The EnDat 2.2 function module, which supports the operation mode “interrupted clock”, allows for the connection of absolute sensors of the types EnDat 2.1 and EnDat 2.2.

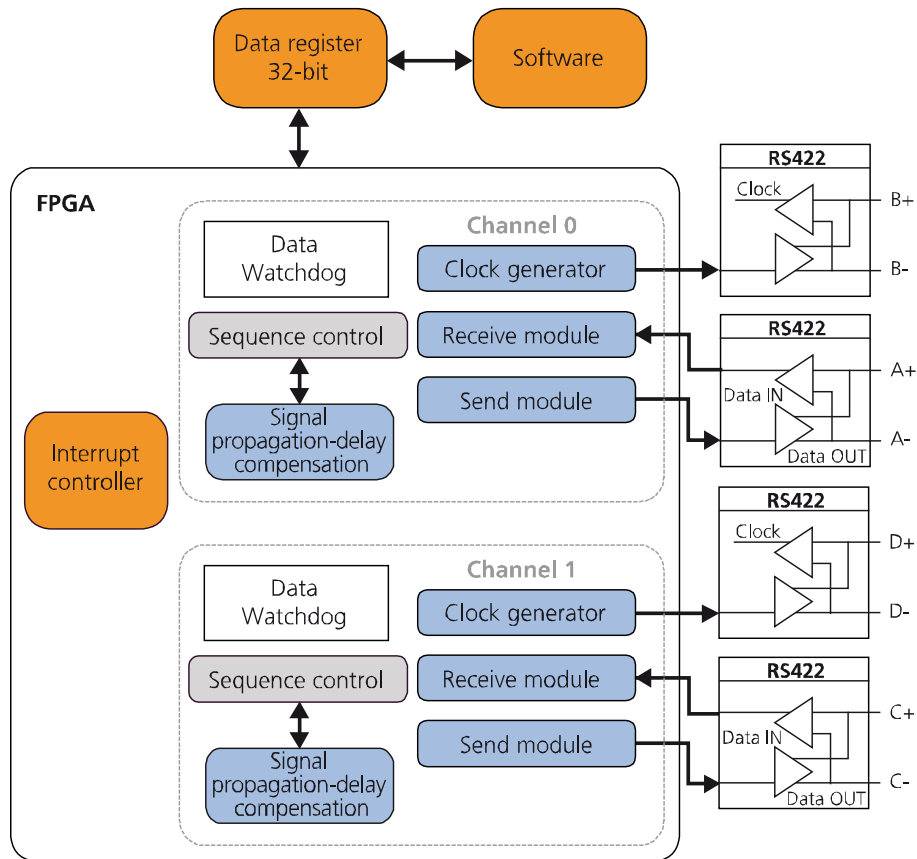
To connect an EnDat 2.1 or EnDat 2.2 sensor with incremental output signals, you have to proceed as follows:

- Program a function module with the function “EnDat 2.2” and another module with the function “Incremental counter”.
- Connect the clock and data lines to the EnDat 2.2 module.
- Connect the incremental tracks A and B to the incremental counter module.

The EnDat 2.2 module analyses the absolute position value from the EnDat 2.2 sensor; the incremental counter module analyses the incremental signals from this sensor.

1.3 Block diagram

Fig. 1-1: Block diagram: “EnDat 2.2” function



Up to 8 EnDat 2.2 sensors can be connected (2 per function module)!

1.4 Used signals

A maximum of eight EnDat 2.2 sensors can be operated on the board **APCLe-1711** or **CPCIs-1711**, i.e. two sensors per function module. Each function module has its own data lines (A and C) and clock lines (B and D).

Table 1-1: Used signals

Channel	Signal name	I/O	Pin name	Function
0	DATA0_x+	Input/Output	Ax+	Data line
	DATA0_x-		Ax-	
	CLK0_x+	Output	Bx+	Clock line
	CLK0_x-		Bx-	
1	DATA1_x+	Input/Output	Cx+	Data line
	DATA1_x-		Cx-	
	CLK1_x+	Output	Dx+	Clock line
	CLK1_x-		Dx-	
Digital I/O	DIG_IN_0_x	Input (24 V)	Ex	Digital inputs for free use
	DIG_IN_1_x	Input (24 V)	Fx	
	DIG_IN_2_x	Input (24 V)	Gx	
	DIG_OUT_Hx	Output (24 V)	Hx	Digital output for free use

x = Number of the function module (0-3)

1.5 Pin assignment: Function modules

Fig. 1-2: Pin assignment: 78-pin D-Sub female connector (4 EnDat modules)

Pin	Pin	Pin	Pin
78	59	39	20
77	58	38	19
76	57	37	18
75	56	36	17
74	55	35	16
73	54	34	15
72	53	33	14
+24 V / U _{Ref} *	52	32	FM3: DIG_IN_0_3
FM3: DIG_OUT_H3	51	31	FM3: DATA0_3-
FM3: CLK1_3-	50	30	FM3: DATA0_3+
FM3: CLK1_3+	49	29	FM2: DIG_IN_0_2
FM2: DIG_OUT_H2	48	28	FM2: DATA0_2-
FM2: CLK1_2-	47	27	FM2: DATA0_2+
FM2: CLK1_2+	46	26	FM1: DIG_IN_0_1
FM1: DIG_OUT_H1	45	25	FM1: DATA0_1-
FM1: CLK1_1-	44	24	FM1: DATA0_1+
FM1: CLK1_1+	43	23	FM0: DIG_IN_0_0
FM0: DIG_OUT_H0	42	22	FM0: DATA0_0-
FM0: CLK1_0-	41	21	FM0: DATA0_0+
FM0: CLK1_0+	40	20	GND

FM = Function module

* Pins 52 and 72: see Technical Description of the board

The following pin assignment applies only if the cable **ST1711-50** is connected to the 78-pin D-Sub female connector of the board. For further information on this, please refer to the Technical Description of the **APCIs-1711** and **CPCIs-1711** (see PDF link).

Fig. 1-3: Pin assignment: 50-pin D-Sub male connector (ST1711-50 cable)

Pin			Pin				Pin			
34	+24 V / U _{Ref} *									
35	FM0: DIG_OUT_H0	Function module 2 (FM2)	18	FM2: DATA0_2+	34	● 18 ●	1	GND	1	Function module 0 (FM0)
36	FM1: DIG_OUT_H1		19	FM2: DATA0_2-	35	● ● ●	2	FM0: DATA0_0+	2	
37	FM2: DIG_OUT_H2		20	FM2: CLK0_2+	36	● ● ●	3	FM0: DATA0_0-	3	
38	FM3: DIG_OUT_H3		21	FM2: CLK0_2-	37	● ● ●	4	FM0: CLK0_0+	4	
39	FM0: DIG_IN_0_0		22	FM2: DATA1_2+	38	● ● ●	5	FM0: CLK0_0-	5	
40	FM1: DIG_IN_0_1		23	FM2: DATA1_2-	39	● ● ●	6	FM0: DATA1_0+	6	
41	FM2: DIG_IN_0_2		24	FM2: CLK1_2+	40	● ● ●	7	FM0: DATA1_0-	7	
42	FM3: DIG_IN_0_3		25	FM2: CLK1_2-	41	● ● ●	8	FM0: CLK1_0+	8	
43	FM0: DIG_IN_1_0	Function module 3 (FM3)	26	FM3: DATA0_3+	42	● ● ●	9	FM0: CLK1_0-	9	
44	FM1: DIG_IN_1_1		27	FM3: DATA0_3-	43	● ● ●	10	FM1: DATA0_1+	10	Function module 1 (FM1)
45	FM2: DIG_IN_1_2		28	FM3: CLK0_3+	44	● ● ●	11	FM1: DATA0_1-	11	
46	FM3: DIG_IN_1_3		29	FM3: CLK0_3-	45	● ● ●	12	FM1: CLK0_1+	12	
47	FM0: DIG_IN_2_0		30	FM3: DATA1_3+	46	● ● ●	13	FM1: CLK0_1-	13	
48	FM1: DIG_IN_2_1	31	FM3: DATA1_3-	47	● ● ●	14	FM1: DATA1_1+	14		
49	FM2: DIG_IN_2_2		32	FM3: CLK1_3+	48	● ● ●	15	FM1: DATA1_1-	15	
50	FM3: DIG_IN_2_3		33	FM3: CLK1_3-	49	● ● ●	16	FM1: CLK1_1+	16	
					50	● 33 ●	17	FM1: CLK1_1-	17	

* Pin 34: see Technical Description of the board

1.6 Connecting the sensors

To each function module, two sensors can be connected.



NOTICE!

Please note that the EnDat 2.2 sensors need a 5 V voltage supply. To see if a different voltage or voltage range is required, please refer to the datasheet for your sensor.

1.6.1 Connection to the screw terminal panel

On the screw terminal panel **PX8001**, the pins of the 50 pin D-Sub female connector and the terminals connected to them are numbered in the same way. Thus, the terminal assignment of the screw terminal panel is identical with the pin assignment of the 50-pin D-Sub male connector on the cable **ST1711-50**.

The following table is to serve as a help for you when connecting the sensors to the screw terminal panel. The blank fields in the "Sensor" column can be filled in on the basis of the selected sensor type.

Table 1-2: Connection of the sensors to the screw terminal panel

Sensor			Screw terminal panel PX8001 (50-pin)							
Pin No.	Pin name	Lead colour (cable)	Signal name	Terminal name	Signal type	Terminal No.				Terminal function
						FM0	FM1	FM2	FM3	
	+24 V / U _{Ref}		+24 V / U _{Ref}	+24 V / U _{Ref}	-	34	34	34	34	see Technical Description of the board
	GND		GND	GND	-	1	1	1	1	Ground
			DATA0_x+	Ax+	-	2	10	18	26	Channel 0: input/output (data line)
			DATA0_x-	Ax-	-	3	11	19	27	
			CLK0_x+	Bx+	-	4	12	20	28	Channel 0: output (clock line)
			CLK0_x-	Bx-	-	5	13	21	29	
			DATA1_x+	Cx+	-	6	14	22	30	Channel 1: input/output (data line)
			DATA1_x-	Cx-	-	7	15	23	31	
			CLK1_x+	Dx+	-	8	16	24	32	Channel 1: output (clock line)
			CLK1_x-	Dx-	-	9	17	25	33	
			DIG_IN_0_x	Ex	24 V	39	40	41	42	Digital inputs for free use
			DIG_IN_1_x	Fx	24 V	43	44	45	46	
			DIG_IN_2_x	Gx	24 V	47	48	49	50	
			DIG_OUT_Hx	Hx	24 V	35	36	37	38	Digital output for free use
			-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-

x = Number of the function module (0-3)

1.6.2 Frequencies and cable lengths

1) Clock frequency

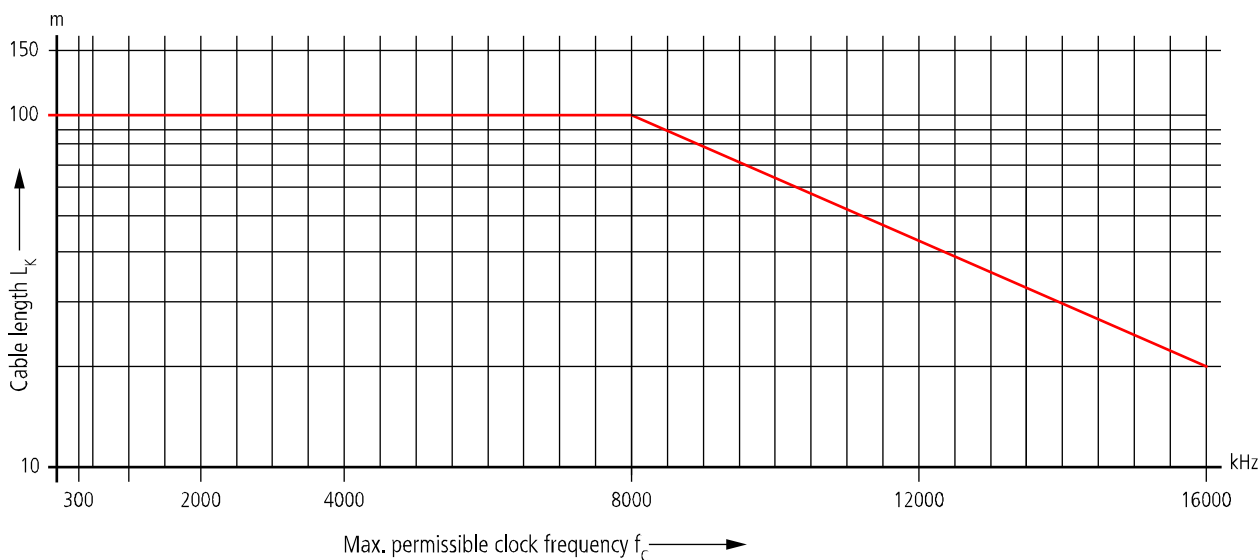
In consideration of the signal propagation delay compensation, which is supported by the EnDat 2.2 function module, a cable length of up to 100 m is possible at a clock frequency ≤ 8 MHz.

**NOTICE!**

The clock frequency range from 8-16 MHz is reserved for special functions and not supported by the EnDat 2.2 function module.

Please note that normally, the maximum clock frequency of EnDat 2.1 sensors is 2 MHz and that of EnDat 2.2 sensors is 8 MHz.

Fig. 1-4: Clock frequency with propagation-delay compensation



2) Transmission frequency

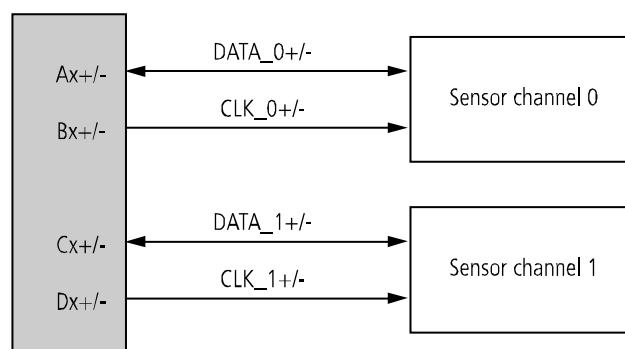
The maximum transmission frequency of the EnDat 2.2 module is 6.666 MHz. The following transmission frequencies are available:

Table 1-3: Transmission frequencies

Programming value	Division factor	Frequency (kHz)
2	6	6666
3	8	5000
4	10	4000
7	16	2500
9	20	2000
15	32	1250
19	40	1000
24	50	800
39	80	500
79	160	250

1.6.3 Connection example

Fig. 1-5: Connection example: EnDat 2.2 sensors



x = Number of the function module (0-3)

DATA = Data input/output

CLK = Clock output

2 Standard software

2.1 Access to the software functions

The API software functions supported by the board are listed in an HTML document. A description on how to access the respective file can be found in the document "Quick installation PC boards" (see PDF link), in the chapter "Standard software".

2.2 Description of the software functions

2.2.1 Initialisation

Software function
i_PCle1711_EndatInitialiseSensor (...)

The initialisation function serves to read out different parameters and registers from the sensor to ensure a correct analysis of the data. Moreover, a reset is carried out with the sensor and the board **APCLe-1711** or **CPCIs-1711**.

For the initialisation function, only EnDat 2.1 mode commands are used. If the sensor supports the EnDat 2.2 command set, the board can also send EnDat 2.2 commands.

2.2.2 Position value request

Software function
i_PCle1711_EndatSensorSendPositionValue (...)

This function is used to request the position values. As the width of the sensor (in bits) is shown by this software function, the position value can be masked.

2.2.3 Position value request with additional data

Software functions
i_PCle1711_EndatSelectAdditionalData (...)
i_PCle1711_EndatSensorSendPositionValueWithAdditionalData (...)

Together with the position value, additional data can be transferred. This data needs to be selected beforehand using the function "i_PCle1711_EndatSelectAdditionalData (...)". This option applies only to EnDat 2.2 sensors.

Where additional data is not supported by the configuration, a corresponding message is displayed. If additional data does not exist, an error message is displayed.

Additional data must be addressed with an MRS code (Memory Range Select Code). For more information, please read the EnDat specification (see Chapter 1).

2.2.4 Error management

Software functions
i_PCle1711_EndatGetErrorSources (...)
i_PCle1711_EndatResetErrorBits (...)

To read the error status of the sensor, the function "i_PCle1711_EndatGetErrorSources (...)" is used. All errors occurred are retained until the error status of the sensor is reset via the function "i_PCle1711_EndatResetErrorBits (...)".

2.2.5 Memory area selection

Software function
i_PCle1711_EndatSelectMemoryArea (...)

This function is used to select the memory area.

2.2.6 Reading and writing parameters

Software functions
i_PCle1711_EndatSensorSendParameter (...)
i_PCle1711_EndatSensorReceiveParameter (...)

The EnDat 2.2 function module enables EnDat 2.1 parameters (from EnDat 2.1 and EnDat 2.2 sensors) and EnDat 2.2 parameters (only from EnDat 2.2 sensors) to be read out. These are parameters set by the sensor manufacturer.

The operating parameters and the operating state can be read out as well.

Each memory area needs to be addressed with an MRS code and each parameter is read out by a specific address. In the same way, the OEM memory area is written on and read out.

2.2.7 Sensor reset

Software function
i_PCle1711_EndatSensorReceiveReset (...)

This function allows you to reset the sensor.

2.2.8 Digital I/O

Software functions
i_PCle1711_ReadInputsEFG (...)
i_PCle1711_WriteOutputH (...)

In addition to the function-specific software functions, the EnDat 2.2 function module also supports the shared functions, i.e. function-independent software functions ("xPCle-1711 Shared functions"). For more detailed information on this, please refer to the HTML document mentioned in Chapter 2.1.

3 Appendix

3.1 Index

Block diagram	7	Digital I/O	16
Clock frequency	12	Error management	15
Connection		Initialisation	14
Sensors	10	Memory area selection	15
Connection example	13	Parameters	15
Features	6	Position value request	14
Pin assignment	9	Sensor reset	15
Signals	8	Transmission frequency	13
Software functions	14	Versions	6
Additional data	14		

4 Contact and support

Do you have any questions? Write or call us:

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

Phone: +49 7229 1847-0

Fax: +49 7229 1847-222

E-mail: info@addi-data.com

Manual and software download from the Internet:

<https://drivers.addi-data.com>