


FLEXCARD PMC II INSTRUCTIONS FOR USE



	<p style="text-align: center;">NOTICE</p> <p style="text-align: center;">ESD (Electro Static Discharge) sensitive product. Refer to chapter 1.3 and follow the safety and handling instructions.</p>
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Any semiconductor devices have an inherent chance of failure. You have to protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions. The safety and handling instructions in this document have to be followed strictly.

EC CONFORMITY

The *FlexCard PMC II* complies with the essential requirements of the following applicable European Community Directive(s) including current amendments, and carries the CE marking accordingly:

- 2004/108/EG EMC Directive

The following standard(s) have been used to assess the product:

- EN 55022:1998 + Corrigendum 07/2003 + A1:2000 + Corrigendum 04/2003 + A2:2003 (Emission characteristics for information technology devices)
- EN 55024:1998 + A1:2001 + A2:2003 (Immunity characteristics for information technology devices)

Electrostatic discharges over 4 kV on the front panel may disturb the bus communication and lead to error frames.

The *FlexCard PMC II* is designed, intended and authorized for industrial use only. Using the product in domestic environment may lead to electromagnetic disturbances.

This product is compliant with the European Community Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

REVISION HISTORY

Version	Date	Description
D1V0-F	27-Feb-2009	Initial release.
D1V1-F	16-Apr-2009	Added FlexTiny II chapter and Linux driver support.
D1V2-F	10-Jul-2009	Updated firmware update chapter and added Xenomai driver support.
D1V3-F	30-Jul-2009	Added user card id chapter. Changed interface description.
D1V4-F	11-Dec-2009	Updates for driver version S6V2-F.

RELATED HARDWARE / SOFTWARE VERSIONS

Product	Reference No.	Version	Remarks
FlexCard PMC II Hardware	3-0055-0A01	H1V1-F	PMC II card with 2 triggers and FlexRay and CAN support depending on the available <i>FlexTiny II</i>
FlexCard PMC II Firmware	3-0055-0C01	S6V2-F	Maximum 4 FlexRay or 8 CAN channels with DMA support.
FlexCard PMC II Firmware	3-0055-0C01	S5V2-F	Maximum 2 FlexRay or 8 CAN channels without DMA support.
FlexTiny II FR iso	3-0056-0A02	H1V0-F	Isolated physical layer board for FlexRay
FlexTiny II CAN-HS iso	3-0056-0B02	H1V0-F	Isolated physical layer board for CAN
FlexTiny II FR	3-0056-0A01	H1V0a-F	Physical layer board for FlexRay
FlexTiny II CAN-HS	3-0056-0B01	H1V0a-F	Physical layer board for CAN
fcBase API (Windows)	3-0009-0K03	S6V2-F	API to build your own application
fcBase API (Linux)	3-0009-0U01	S5V1-F	API to build your own application
fcBase API (Xenomai)	3-0009-0V01	S5V1-F	API to build your own application
Caromee	3-0051-0P01	S1V4F-F	Analyzing software that can be easily extended and supports the FlexCard product family.

Further related hardware and software can be found in chapter Scope of supply.

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1 GENERAL

1.1 INTENDED USE

The *FlexCard PMC II* is a PCI Mezzanine Card for use in 32bit/33MHz capable PMC carriers which are available for several host system architectures.

The *FlexCard PMC II* is solely used to access FlexRay and CAN bus systems. Appropriate installed *FlexTiny II* with the according firmware, license and software are required to read from or write to multiple FlexRay and CAN buses. For FlexRay, channel A and B is supported for each communication controller.

Only the herein described accessory parts are allowed to be used together with the *FlexCard PMC II*.

The *FlexCard PMC II* is designed, intended and authorized exclusively for

- a) EU: laboratory applications
- b) US: industrial test equipment

Any other use without the prior written consent of *Eberspächer Electronics* is prohibited.

The *FlexCard PMC II* is NOT designed, intended or authorized for



- use as part of medical systems,
- life support applications,
- aviation, space, nuclear or military applications,
- use in areas where combustible or explosive gas mixtures are likely to occur,
- other applications in which a mistake or malfunction may result in death, personal injury or severe physical damage.






The product described in this document is an industrial device, i.e. is designed, intended or authorized for professional use. It is not designed, intended or authorized for home applications or consumers.

1.2 USED PICTOGRAMS

The meaning of used pictograms is shortly described below.

Follow the specific instructions in the document where these pictograms are placed.

	⚠ WARNING
	Used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	⚠ CAUTION
	Used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

	NOTICE Used to indicate a situation which may result in an operating failure. Damage of the product may occur, but there is no hazard of injury if not avoided.
	NOTICE Used to indicate an electrostatic discharge sensitive product. The product is subject to damage by ESD, if no precautions are taken.
	Information Used to indicate information provided only for purposes of clarification, illustration, and general information.
	Reference References another document.
	Product marking which shows the compliance of the product with the European Waste Electrical and Electronic Equipment Directive 2002/96/EC.

1.3 SAFETY AND HANDLING INSTRUCTIONS


Please read the instructions for use carefully. To protect the device or the application against damage or to avoid personal injury the *FlexCard PMC II* has to be handled as described herein.


Changes or modifications of the *FlexCard PMC II* are not allowed for safety and warranty reasons!


Eberspächer Electronics is not liable for any damages arising from non-observance of the product information.


Follow the


- specific safety and handling instructions placed at dedicated document positions
- general safety and handling instructions below:

	⚠ WARNING MAINS VOLTAGE UP TO 110 / 230 VAC AT THE COMPUTER CHASSIS ELECTRICAL SHOCK HAZARD! TO PREVENT DEATH, PERSONAL INJURY OR DAMAGE: DISCONNECT THE POWER CABLE OF THE COMPUTER BEFORE OPENING THE CHASSIS.
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	⚠ CAUTION
	<p>TO PREVENT PERSONAL INJURY, TO PREVENT DAMAGE TO THE <i>FlexCard PMC II</i> OR TO PREVENT CONSEQUENTIAL DAMAGES:</p> <ul style="list-style-type: none"> ➤ PLEASE OBSERVE THE ESD-PROTECTION INSTRUCTIONS BEFORE GETTING IN CONTACT WITH THE CONNECTORS. OTHERWISE THE <i>FLEXCARD PMC II</i> MAY GET DAMAGED. SEE APPENDIX A: GUIDELINE FOR HANDLING ESD SENSITIVE PRODUCTS. ➤ DO NOT CONNECT ANY OTHER SIGNALS TO THE INTERFACES AS DESCRIBED IN THE CHAPTER "INTERFACES AND CONNECTORS". ➤ ENSURE THAT ALL SIGNALS ARE WITHIN THE SPECIFIED RANGE. ➤ IT IS RECOMMENDED TO ONLY USE PRODUCTS FROM EBERSPÄCHER ELECTRONICS LISTED IN CHAPTER 8.2 ACCESSORY PARTS TO ENSURE PROPER FUNCTION! ➤ HIGH TEMPERATURES CAN DAMAGE THE <i>FLEXCARD PMC II</i>. KEEP THE <i>FLEXCARD PMC II</i> AWAY FROM HEATERS, STOVES, FIREPLACES, AND OTHER SOURCES OF HEAT. ➤ DO NOT EXPOSE THE <i>FLEXCARD PMC II</i> TO RAIN OR USE IT NEAR WATER. ➤ DO NOT USE THE <i>FLEXCARD PMC II</i> IN AREAS OF EXPLOSION HAZARD.

	NOTICE
	<p>The <i>FlexCard PMC II</i> may not work correctly or communication problems may occur if:</p> <p>The <i>FlexCard PMC II</i> is used in existing passive networks, i.e. when changing the topology structure.</p> <p>The coded 8-pole FlexRay connectors are inserted wrong (i.e. due to forced insertion).</p> <p>The bus termination of the <i>FlexCard PMC II</i> is not adapted to the connected bus topology.</p> <p>The <i>FlexCard PMC II</i> is configured wrong.</p>

	NOTICE
	<p>By sending messages over the <i>FlexCard PMC II</i> to an automotive bus system it is possible to trigger actions resulting in malfunction and/or damage.</p> <p>The <i>FlexCard PMC II</i> must be used by expert technicians familiar with the corresponding systems.</p>

	NOTICE
	<p style="text-align: center;">ESD (Electro Static Discharge) sensitive product</p> <p style="text-align: center;"><i>Eberspächer Electronics</i> products lacking protective enclosures are subject to damage by ESD.</p> <p style="text-align: center;">Take proper ESD precautions to avoid performance degradation or loss of functionality!</p> <p style="text-align: center;">Unpack, handle or operate these products only in environments where sufficient precautionary measures have been taken in respect to ESD hazards.</p> <p style="text-align: center;">A guideline is available in chapter 9.1.</p> <p style="text-align: center;">Only appropriately trained personnel (such as electricians, technicians and engineers) may handle and/or operate these products.</p>

1.4 USER GROUP

This document is written for expert technicians who are familiar with electronic components and systems.

Each person involved with assembly, line-up, operation, maintenance, or disposal of the *FlexCard PMC II* has to

- be a qualified technician, or electrician, or engineer
- strictly adhere to this manual
- receive a briefing by an authorized person

1.5 MEANING OF TEXT STYLES

In this document *filenames* are marked with a different text format.

2 PRODUCT DESCRIPTION

2.1 FLEXCARD PMC II AT A GLANCE

The *FlexCard PMC II* is a flexible multi-bus instrument for monitoring, testing, simulation and basic gateway applications. It is intended to be used with the FlexRay and CAN bus systems. The number of interfaces may easily be varied by mounting up to four *FlexTiny II* modules. This ensures a free and future-oriented field of application.

Several features like switchable bus terminations, two trigger lines as well as the easily updateable firmware are integrated on the device. Using different monitoring modes, the card can be used as pure monitoring tool and as real communication node for FlexRay and CAN.


The *FlexCard PMC II* can be inserted in a 32bit/33MHz capable PMC chassis or carrier module. Such carrier modules are available for several platforms like PCI, PCIe, CompactPCI or PXI.


FEATURES

- 32bit/33MHz **PCI Mezzanine Card** device
- 4 slots for *FlexTiny II* modules, allows maximum 4 channels FlexRay (A+B), 8 channels CAN or a combination
- 2 TTL compatible trigger lines
- Firmware updateable

The bus systems are connected via four Binder Series 712 jacks. Each Binder jack connects either channel A and B for FlexRay or two bus channels for CAN. For each channel two LED indicators are provided on the front panel signaling different states of the bus channels.

Up to API- and FW-Version S5V2-F, all incoming data is temporarily stored into the 2MB onboard buffer of the device. 1MB is used for data buffering, 1MB for internal processes. From API- and FW-Version S6V1-F, all incoming data is transferred over DMA from device to the system RAM and temporarily stored into a 2MB receive buffer. In both cases data losses are prevented and flexible data collection cycles become possible. Transmit data will be written directly into the Communication Controller in order to ensure a maximum of performance.

	Reference
	Further information about how to program applications for the <i>FlexCard PMC II</i> can be found in the <i>FlexCard API Documentation</i> .

	Information
	The currently supported FlexRay Communication Controller type on the <i>FlexCard PMC II</i> is: BOSCH E-Ray FlexRay IP-Module, Release 1.3 (Referring to the FlexRay protocol specification v2.1a)
	The currently supported CAN Communication Controller type on the <i>FlexCard PMC II</i> is: BOSCH D_CAN CAN IP-Module Release 1.0 (Referring to the CAN protocol specification v2.0 part A, B)
	Other versions are not supported up to now. Please contact <i>Eberspächer Electronics</i> if other versions need to be supported. The firmware can be exchanged using the update tool <i>FlexUpdate.exe</i> .

Applications

- Usage with Eberspächer Electronics *Caromee* (Demo available)
- Usage with Eberspächer Electronics *FlexAnalyzerV2* (See chapter 2.2 Scope of supply)
- Further commercial applications will support *FlexCard PMC II* soon
- Usage with customer specific software. The FlexCard driver has a C-API, see [1].

2.2 SCOPE OF SUPPLY


The *FlexCard PMC II* is delivered with

Product	Reference No.	Version	Remarks
<i>FlexCard PMC II</i> Hardware	3-0055-0A01	H1V1-F	PMC/PCI card with 2 triggers and FlexRay and CAN support depending on the available <i>FlexTiny II</i> .
<i>FlexCard PMC II</i> Firmware	3-0055-0C01	S6V2-F and S5V2-F	Maximum 4 FlexRay, 8 CAN channels or a combination.
<i>FlexCard SYS</i>	3-0009-0E04	S6V2-F	Required low level driver for the <i>FlexCard</i> .
<i>FlexCard DLL</i>	3-0009-0K03	S6V2-F	Required high level driver for the <i>FlexCard</i> .
<i>FlexCard Linux driver</i>	3-0009-0U01	S5V1-F	Linux driver for the <i>FlexCard</i> .
<i>FlexCard Xenomai driver</i>	3-0009-0V01	S5V1-F	Xenomai driver for the <i>FlexCard</i> .
<i>FlexAnalyzerV2</i>	3-0038-0B01	S1V3-F	<i>FlexCard</i> monitoring tool. Supports FlexRay/CAN monitoring and sending data, triggers, filters and data logging.
Instructions for Use	3-0055-0P01-D05	D1V4-F	This document.
API Documentation	3-0009-0S01-D03	D1V14-F	API programming manual as PDF file.
Getting Started Manual	3-0055-0P01-D07	D1V2-F	Example how to build a small FlexRay/CAN-communication.
Demo	-	S1V6-F	Demo explaining the programming of the <i>FlexCard</i> .
DemoPMC	-	S1V5-F	Demo explaining the programming of the <i>FlexCard</i> with multiple FlexRay CCs.
DemoCAN	-	S1V4-F	Console application explaining the communication over CAN.
CanBaudRateCalculator	-	S1V6-F	Helps with the calculation of CAN bus parameters.
FlexUpdate	-	S1V7-F	Tool for updating firmware and licenses.
Tracer Control	-	S1V2-F	Activates debug information.

Table 1: Scope of supply of the FlexCard PMC II

A list of available accessory parts can be found in chapter 8.2.

2.3 UPDATES

	Information
	<p>Updates regarding the FlexCard drivers and firmware are possible via web-downloads from the <i>Eberspächer Electronics</i> homepage.</p> <p>The firmware on the <i>FlexCard PMC II</i> can be updated with an appropriate software tool, see chapter 4.3.2.</p> <p>If you mount an additional or different <i>FlexTiny II</i> module, a license update could be necessary. See chapter 4.5 on how to update your license.</p>

3 TECHNICAL DATA

3.1 ELECTRICAL CHARACTERISTICS

The necessary power is directly provided by the PCI bus through the PMC interface. The typical power consumption when operating the *FlexCard PMC II* is 1.6 W.

Supply voltage	+3.3 VDC	+5 VDC
Supply current (typical)	100 mA	250 mA

Table 2: Electrical characteristics of the *FlexCard PMC II*

3.2 PHYSICAL CHARACTERISTICS

CPU of <i>FlexCard PMC II</i>	Altera Cyclone III
Bus Interfaces Bus Drivers on FlexTiny II	8 bus channels provided on the front panel FlexRay: NXP TJA1080 Transceivers CAN: NXP TJA1041 CAN HS Transceivers
Bus Termination	The bus termination can be switched by software. CAN is terminated with 120Ω, FlexRay with 90Ω
Bus state LEDs	Two LED-indicators per channel
Synchronization Interfaces on the front panel	2x 5V TTL trigger connectors provided on the front panel
Dimensions L x W x H without connectors approx.	149 x 74 x 21 mm

Table 3: Physical characteristics of the *FlexCard PMC II*

3.3 ENVIRONMENTAL CONDITIONS

Temperature	Operating: -40 to +70°C Storage: -40 to +85°C
Relative Humidity	Operating: 10% to 90% rH, non-condensing Storage: 10% to 90% rH, non-condensing

Table 4: Environmental conditions for the *FlexCard PMC II*

3.4 BLOCK DIAGRAM

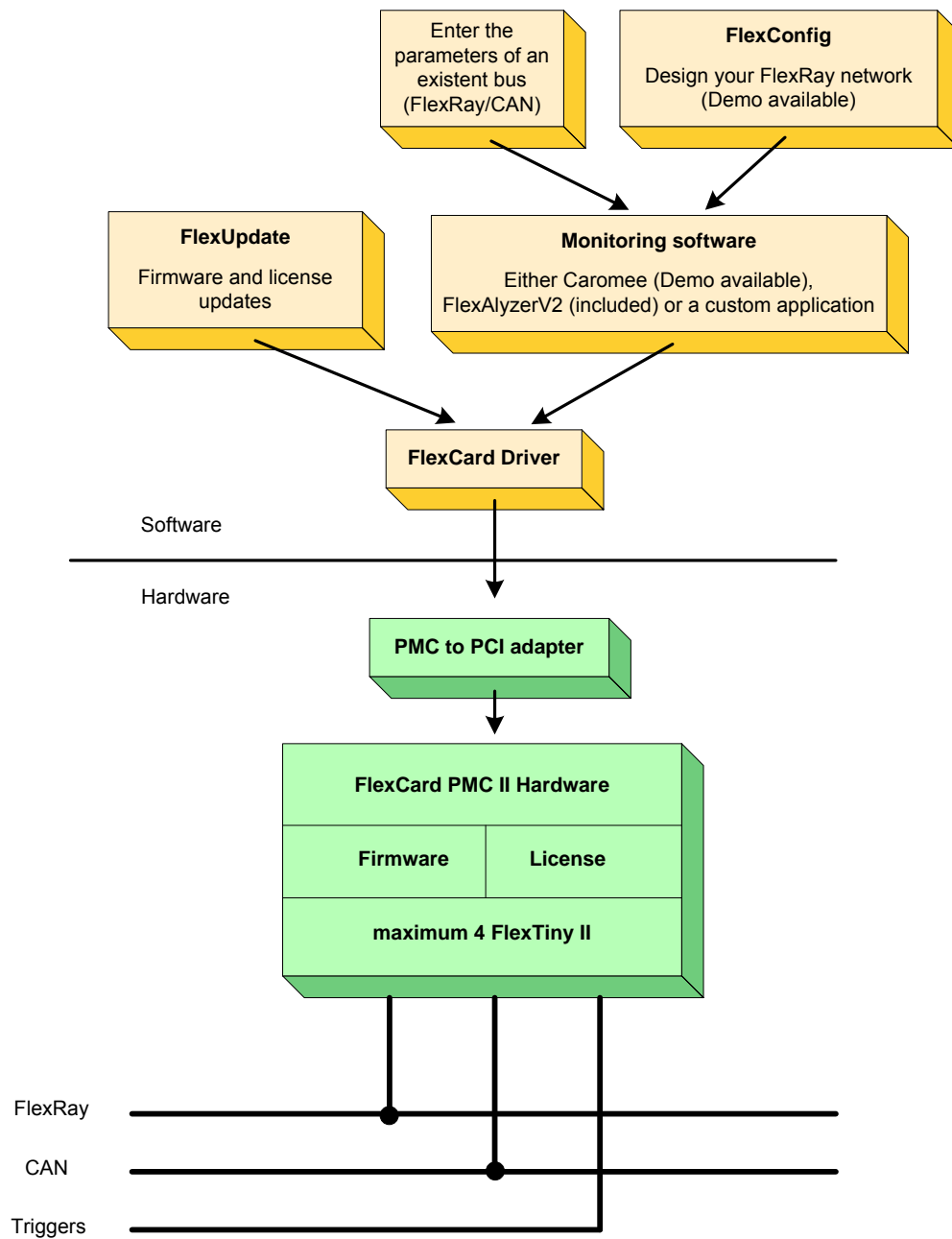



Figure 1: The *FlexCard PMC II* in a functional environment

	Reference
	Further information about the usage of <i>FlexAnalyzerV2</i> , <i>Caromee</i> and <i>FlexConfig</i> can be found in [3], [4], [5].

3.5 INTERFACES AND CONNECTORS

Read and follow these instructions when connecting and using the *FlexCard PMC II*:

	NOTICE
	<p>Ensure that all signal lines connected to the <i>FlexCard PMC II</i> are in the allowed range.</p>
	<p>Be sure to connect all cables as described in this manual. It is recommended to only use cables from <i>Eberspächer Electronics</i>. See Chapter 8.2 Accessory parts.</p>
	<p>The cables for the bus channels should always be fixated by screwing the plug into the jack. Ensure to grasp the plug and not the cable when disconnecting the <i>FlexCard PMC II</i>.</p>

3.5.1 PMC INTERFACE

The *FlexCard PMC II* can be driven with both 3.3V and 5V PCI-buses, because of its 5V tolerant components. The *FlexCard PMC II* is running on 32 Bit PCI.

3.5.2 BUS INTERFACES ON THE FRONT PANEL

On the front panel, four Binder series 712 jacks are provided for the bus connections.

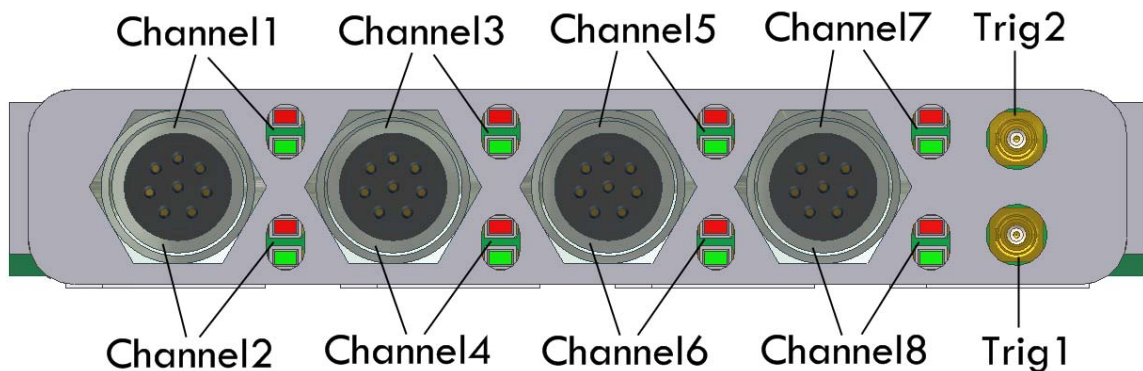


Figure 2: Front panel

One bus connector may contain either FlexRay channel A and B or two CAN channels.

For both bus types (FlexRay and CAN), the same pin assignment and the same cables are used. Physically, the differentiation between the bus systems is only done by the FlexTiny II modules.

The pin assignment of the *FlexCard PMC II* connectors is shown in Figure 2 and is listed in Table 4. Whether FlexRay or CAN is connected depends on the mounted FlexTiny II module. When using isolated FlexTiny II modules both pin 2 and pin 8 are isolated grounds.

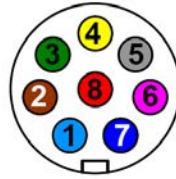


Figure 3: Front panel jack pin assignment, front view of the 8 pin Binder 712 female connector

Pin number Binder 712 female	Signal	Color
1	Shield	Blue
2	GND	Brown
3	Interface 1: FlexRay BusPlus or CAN high	Green
4	Interface 1: FlexRay BusMinus or CAN low	Yellow
5	Interface 2: FlexRay BusPlus or CAN high	Grey
6	Interface 2: FlexRay BusMinus or CAN low	Pink
7	Not connected	Blue
8	GND	Red

Table 5: *FlexCard PMC II* Binder connector assignment

Maximum voltage input on a FlexRay BP/BM: 60V

Minimum voltage input on a FlexRay BP/BM: -60V

Maximum voltage input on a CAN high/low: 40V

Minimum voltage input on a CAN high/low: -27V

The *FXC FCL8-2 Cable* (Ref. No. 3-0034-1L01) has a female Binder 722 connector (See Figure 3) and two female SubD connectors (See Figure 4). One connector is labeled as Channel A, it carries FlexRay channel A or CAN interface 1, 3, 5 or 7. The second connector is labeled as Channel B and it carries FlexRay channel B or CAN interface 2, 4, 6 or 8, depending on the Binder 722 jack it is connected to.

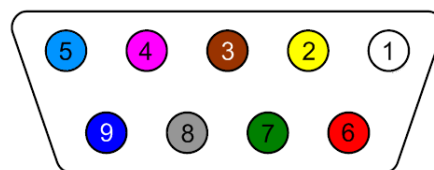



Figure 4: SubD9 pin assignment, front view

Pin number SubD9 female	Signal	Color
1	Not connected	
2	Interface 1: FlexRay BusMinus or CAN low	Yellow
3	GND	Brown
4	Not connected	Magenta
5	Shield	Blue
6	Not connected	Red
7	Interface 1: FlexRay BusPlus or CAN high	Green
8	Not connected	Grey
9	Not connected	Blue

Table 6: *FXC FCL8-2 Cable* (Ref. No. 3-0034-1L01) SubD9 cable assignment, first male connector

Pin number SubD9 female	Signal	Color
1	Not connected	
2	Interface 2: FlexRay BusMinus or CAN low	Yellow
3	GND	Brown
4	Not connected	Magenta
5	Shield	Blue
6	Not connected	Red
7	Interface 2: FlexRay BusPlus or CAN high	Green
8	Not connected	Grey
9	Not connected	Blue

Table 7: *FXC FCL8-2 Cable* (Ref. No. 3-0034-1L01) SubD9 cable assignment, second male connector

	Information
	The <i>FC Daisy Chain FR 2 Cable</i> is available for the <i>FlexCard PMC II</i> . It connects 4 Sub-D jacks to the <i>FlexCard</i> . Therefore four bus nodes may be connected. See Chapter 8.2 for ordering information.

3.5.3 BIDIRECTIONAL TRIGGER CONNECTORS ON THE FRONT PANEL

For synchronization purposes, the *FlexCard PMC II* provides two 5V tolerant TTL-compatible trigger connectors (Trig1 and Trig2, see Figure 2) on the front panel. The device has the ability to receive and generate trigger events on both trigger connectors. This feature allows e.g. a synchronization of different bus analyzing hardware. Physically, the triggers are MMCX-male-connector for coax-cables. The electrical characteristic of this output is described in Table 8. The values in between brackets are for a *FlexCard PMC II* that is plugged into a 3.3V PCI-slot instead of a 5V slot. Figure 5 describes how to identify a 3.3V and a 5V PCI slot.

Parameter	Min	Typ	Max	Units
Input High Voltage	2.4	-	5 (3.3)	V
Input High Current	4	-	12	mA
Input Low Voltage	-	-	0.8	V
Output High Voltage	4 (2.7)	4.5 (3)	5 (3.3)	V
Output High Current	-	4	10	mA
Output Low Voltage	0	0.5	0.8	V

Table 8: Electrical characteristic of trigger connections

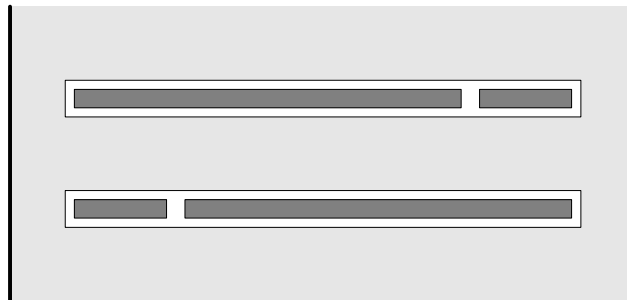




Figure 5: Top view of a motherboard. Connectors of the PCI card are at the left side. At the top is a 5V PCI slot; below is a 3.3V PCI slot.

Both trigger connectors can freely be configured by software to act as input or as output. They can be programmed to work with rising or falling edges.

	Reference
	Detailed information about how the trigger events are used with the <i>FlexCard PMC II</i> can be found in the <i>FlexCard API Documentation</i> .
	Information
	To connect the trigger output to a BNC-connector, the trigger line cable can be ordered at <i>Eberspächer Electronics</i> , see chapter 8.2 Accessory parts.

3.5.4 LED INDICATORS ON THE FRONT PANEL

Each bus channel on the front panel has two LED indicators for signaling different monitoring states: Red and green. The information signaled by the LED depends on the mounted *FlexTiny II* at the corresponding slot. When no LED is glowing, no *FlexTiny II* is mounted or no bus activity is detected. The LED states are explained in the following table:

Signaling	Mounted FlexTiny II	Description
Permanent red lighting of all LEDs	FlexRay or CAN	Signals a buffer overflow on the internal RAM.
Red flashing	FlexRay	Signals an error in the FlexRay communication controller (e.g. clock correction errors).
Red and green lighting at the same time	FlexRay	FlexRay communication controller is not synchronized, but connected to an actively working network. Bus traffic is detected. This LED combination is active when monitoring in asynchronous mode. The intensity of the LEDs is dependent on the traffic on the bus.
	CAN	Bus traffic is detected. The intensity of the LEDs is dependent on the traffic on the bus.
Green lighting	FlexRay	FlexRay communication controller is synchronized. The intensity of the LED is dependent on the traffic on the bus.

Signaling	Mounted FlexTiny II	Description
Green flashing	FlexRay	Signals the FlexRay communication controller is in a startup path (that means that the FlexRay communication controller is ready for synchronization). This can be seen when monitoring in normal mode and the FlexRay configuration is incorrect or no cable connected.

Table 9: Description of indicating LEDs

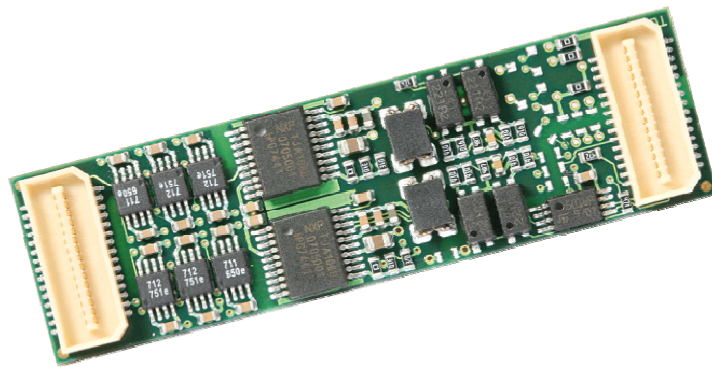
3.5.5 FLEXTINY II MODULES

The *FlexCard PMC II* hardware provides 4 *FlexTiny II* connectors.

Currently there are four different *FlexTiny II* modules available for the *FlexCard PMC II*:

- *FlexTiny II FR iso*: The isolated *FlexTiny II* module allows access to a FlexRay bus. It supports channel A and channel B.
- *FlexTiny II FR*: Like *FlexTiny II FR iso*, but not isolated.
- *FlexTiny II CAN-HS iso*: Allows isolated access to a CAN bus. Two channels are supported.
- *FlexTiny II CAN-HS*: Like *FlexTiny II CAN-HS iso*, but not isolated.

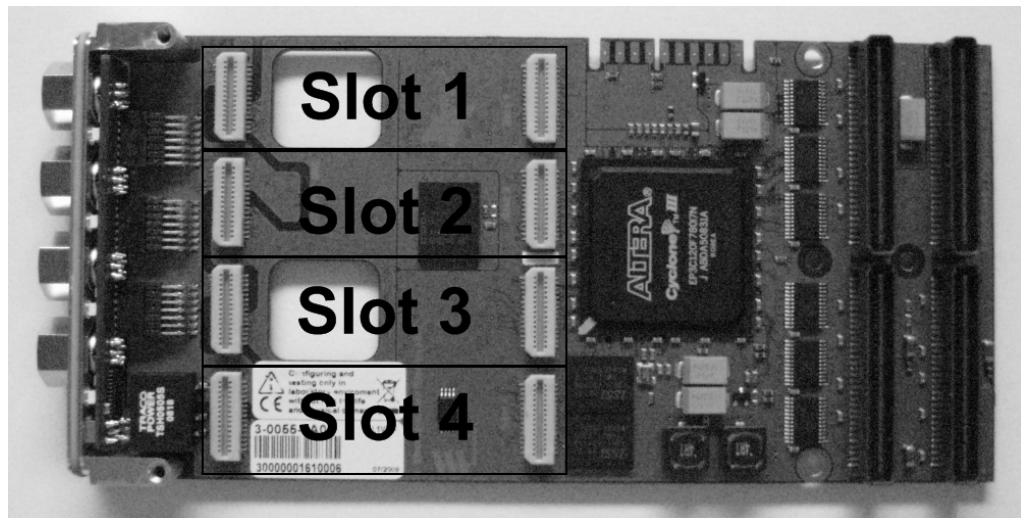
Information	Information
	The isolation of the FlexRay/CAN bus from the <i>FlexCard PMC II</i> works only when all mounted <i>FlexTiny II</i> modules are isolated modules.


Figure 6: Isolated *FlexTiny II* module with physical layer chips to access different bus systems.

3.5.6 MOUNTING THE FLEXTINY II MODULES

The *FlexCard PMC II* supports a multitude of configurations.

The following figure shows the assignment of the *FlexTiny II* modules with the *FlexCard PMC II* hardware.


Figure 7: Assignment of *FlexTiny II* modules

To mount the correct *FlexTiny II* modules on the *FlexCard PMC II*, put the FlexRay modules on slot 1, slot 2 and so forth. Then mount the CAN modules on the following slots. Please refer to Table 10.

Used Firmware	FlexTiny II assignment			
	Slot 1	Slot 2	Slot 3	Slot 4
8 CAN	CAN	CAN	CAN	CAN
1 FlexRay and 6 CAN	FlexRay	CAN	CAN	CAN
2 FlexRay and 4 CAN	FlexRay	FlexRay	CAN	CAN
3 FlexRay and 2 CAN	FlexRay	FlexRay	FlexRay	CAN
4 FlexRay	FlexRay	FlexRay	FlexRay	FlexRay

Table 10: *FlexTiny II* assignment in dependency of the used *FlexCard PMC II* firmware

NOTICE	
	<p>Ensure that all <i>FlexTiny II</i> modules are mounted correctly!</p> <p>To avoid <i>FlexCard PMC II</i> hardware damage ensures that the Eberspächer writing on the <i>FlexTiny II</i> modules are pointing towards the Cyclone III chip and not to the front panel.</p>

Push the *FlexTiny II* module softly into the slot you wish to use. It clicks into place. The shape of the connector prevents a wrong orientation. The slot number is printed on the board. Slot 1 connects interface 1 and 2, slot 2 connects interface 3 and 4 etc.

Be careful when you want to take off the *FlexTiny II*. Push the module of slot 1 and 3 out through the two holes in the board. For the other two, place the fingertips of your index finger and thumb of both hands under the module and use them as lever.

Information	
	<p>When a new <i>FlexTiny II</i> is mounted, make sure that you have the correct license. Refer to chapter 4.1 Licenses.</p>


4 GETTING STARTED

4.1 LICENSES


Eberspächer Electronics licenses the number of Communication Controllers that may be used. Currently maximum 4 FlexRay CCs and 8 CAN CCs are possible. The firmware, the collection of *FlexTiny II* modules and the license are necessary for a functional device. If there are more communication controllers available than that are licensed, only the licensed CCs will be accessible.

Also the usage of the *FlexCard PMC II* on Linux, Xenomai and with the LabVIEW driver requires a license. Please contact Eberspächer Electronics if you want to obtain a license file and refer to chapter 4.5 on how to update the FlexCard.

4.2 HARDWARE INSTALLATION AND MAINTENANCE

	NOTICE
	<p>Be aware that the <i>FlexCard PMC II</i> and the <i>FlexTiny II</i> are electrostatic discharge sensitive devices. Please refer to Appendix A: Guideline for handling ESD sensitive products.</p> <p style="text-align: center;">Do not touch the components on the board or the pin connectors.</p>

First, the *FlexTiny II* modules you want to use are mounted onto the *FlexCard*. Refer to chapter 3.5 Interfaces and connectors.

	NOTICE
	<p>Use only <i>FlexTiny II</i> modules from <i>Eberspächer Electronics</i> listed in chapter 8.2 Accessory parts to ensure proper function and for warranty reasons!</p>

Then the *FlexCard PMC II* is mounted onto a PMC-to-PCI-adaptor. *Eberspächer Electronics* recommends using the following PMC to PCI adapter:

- TPCI270 PCI-to-PMC adapter from TEWS

For ordering information, please refer to chapter 8.2 Accessory parts.

Follow these steps to install the *FlexCard PMC II* in your PCI system:


1. Turn your host system off and unplug the power cable.
2. Ensure that you fulfill the EMC conformity and safety requirements. The technician should be grounded.
3. Insertion and removal of the *FlexCard PMC II* should be done with care.
4. Insert the *FlexCard PMC II* into a free module slot of your PCI host / carrier module.
5. Fixate the *FlexCard PMC II* with the screws to the host / carrier module.

4.2.1 CUSTOMIZE THE BUS DRIVER TERMINATING RESISTOR VALUES

For each bus channel, a bus termination can be switched on or off, so that different bus topologies are supported for FlexRay and CAN-HS bus. FlexRay needs terminating resistor values of 90Ω (split termination), whereas CAN-HS requires values of 120Ω. The settings for the bus termination can be done via software. Therefore please read the *FlexCard* API Documentation how the termination can be adapted to the specific needs.

4.3 SOFTWARE INSTALLATION AND UPDATE

4.3.1 PRECONDITIONS

	Information
	On all operating systems administrator access rights are required to install the device driver.

The minimum system requirements for installing and running the *FlexCard PMC II* hardware and software are:

Microsoft Windows 2000 with Service Pack 4 or higher

- Computer/processor: 1 GHz or faster AMD/Pentium-compatible processor
- 256 MB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- Free PMC-, PCI- or PCIe-slot

Microsoft Windows XP

- Computer/processor: 1 GHz or faster AMD/Pentium-compatible processor
- 256 MB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- Free PMC-, PCI- or PCIe-slot

Microsoft Windows Vista

- Computer/Processor: 1.5 GHz or faster AMD/Pentium-compatible processor
- 1 GB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- Free PMC-, PCI- or PCIe-slot

LabVIEW

- Computer/Processor: 2 GHz or faster AMD/Pentium-compatible processor
- 512 MB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- Free PMC-, PCI- or PCIe-slot

Linux (with/without Xenomai)

- Computer/Processor: 1 GHz or faster AMD/Pentium-compatible processor
- 256 MB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- Free PMC- or PCI-slot
- Supported Linux kernel version: 2.6.16 to 2.6.29
- Optional supported Xenomai version: 2.4

For the PCI-Express adapter, we recommend using the following controller. It is tested and compatible with the *FlexCard PMC II*:

- Technobox PMC-to-PCI Express Adapter 1 Lane, part number 5243

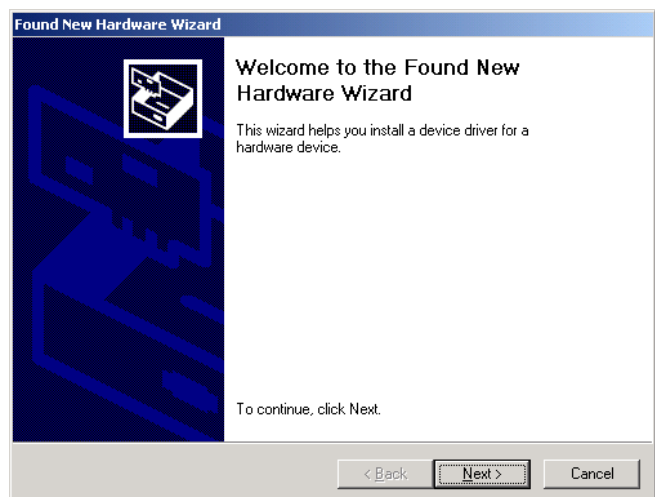
4.3.2 INSTALLATION ON MICROSOFT WINDOWS OPERATING SYSTEMS

To install the *FlexCard PMC II* device driver and dynamic link library, please follow the steps below. Before you install the *FlexCard PMC II*, uninstall the old version first (Refer to chapter 4.3.3 Uninstallation on Microsoft Windows operating systems).

Step 1

Insert the *FlexCard PMC II* hardware in the PCI – slot. Switch the power on and boot your computer. Windows will show this dialog.

As the device driver will not be installed using the “New Hardware Wizard”, click on the “Cancel” button to abort the wizard.



Step 2 (a)

To start the installation, double click the file *FlexCard_Setup_SxVy-F.exe*. The installation wizard will start immediately and guide you through the installation.

Click on the “Next” button.

Note: On a Windows 2000 system, make sure that you have the Windows Installer 2.0 installed.



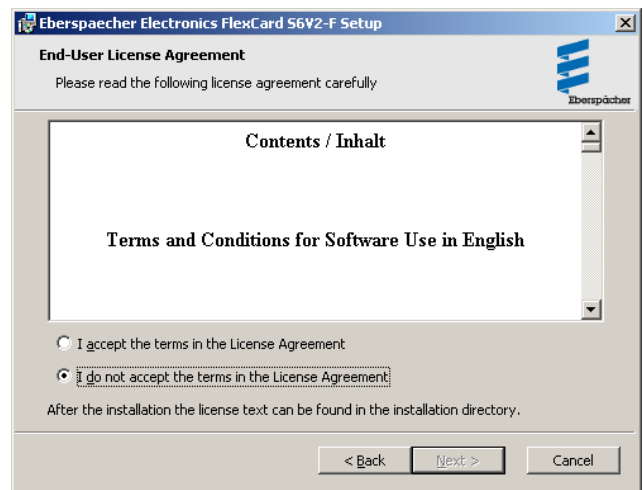
Step 2 (b)

If you installed a *FlexCard* driver package before, the setup will return this error message. For installing the new driver you have to **remove** the previous package first.

Follow the instructions in chapter 4.3.3 Uninstallation on Microsoft Windows operating systems. **Restart** your computer and go to **Step 1** again.

Step 3

Read the license agreement and if you accept the agreement, click "*I accept the terms...*" and the "*Next*" button to continue the installation. Otherwise click "*Cancel*" to abort the installation.

**Step 4**

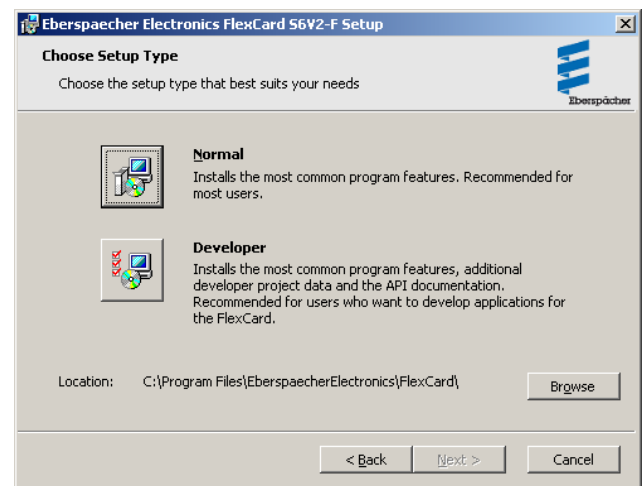
Select the installation folder for the *FlexCard* files.

There are two setup types:

- **Normal** setup for using *FlexCard PMC II* with commercial applications.
- **Developer** setup for developing applications for the *FlexCard PMC II*. This will install the C header files and libraries you need, to access the API in your own applications. Also the *FlexCard* API Documentation is installed.

Choose your setup type by clicking the corresponding icon.

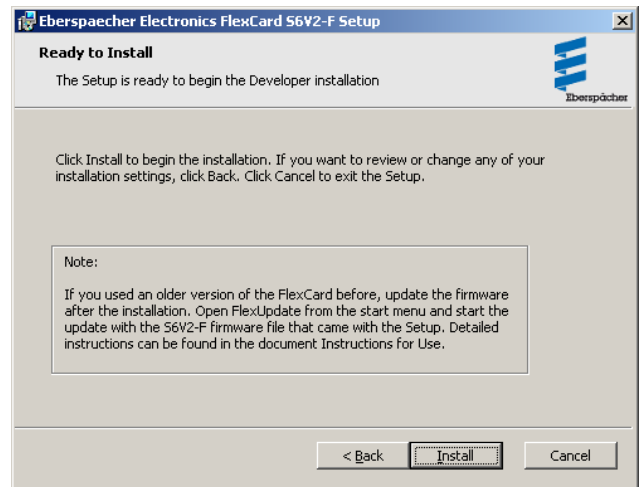
Note: The device driver and dynamic link library will be installed to the Windows system directory.



Step 5

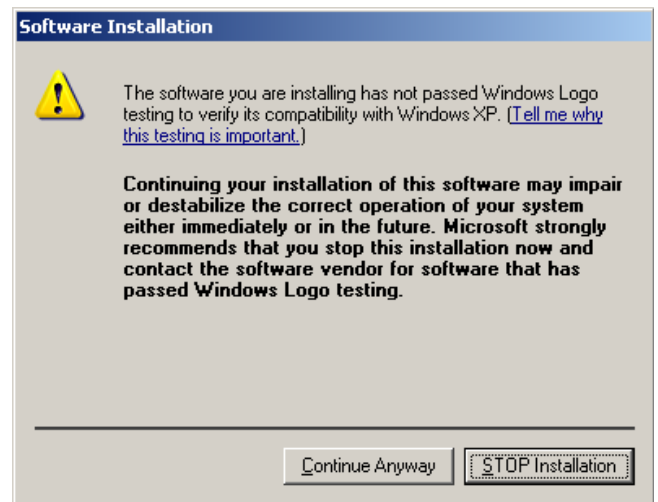
Please note that the *FlexCard PMC II* only works when the firmware and the driver match. If you update the *FlexCard PMC II* from an earlier version, update the firmware too. After the installation, look for the firmware file that came with the new setup. Refer to chapter 4.4 “Firmware Update” on how to update the firmware.

Click “*Install*” to start the installation.



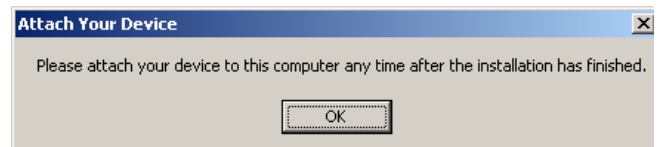
Step 6

On a Windows system the following warning dialog may appear, as the *FlexCard* device driver is not certificated by the Microsoft Hardware Quality Labs. Click on “*Continue Anyway*” to proceed with the installation.



Step 7

A dialog box appears. Click on “*OK*”.



Step 8

Click “*Finish*” to complete the installation.



Step 9

After the installation of the device driver you will find the *FlexCard PMC II* entry in the *Device Manager* in the folder *Multifunction adapters*.



4.3.3 UNINSTALLATION ON MICROSOFT WINDOWS OPERATING SYSTEMS

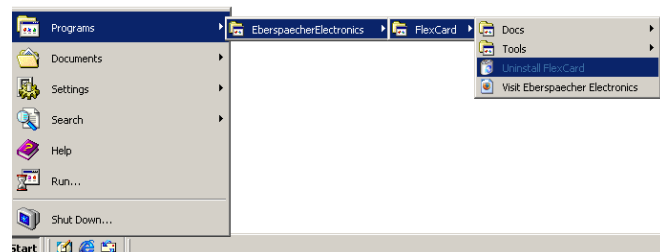
Uninstall alternative 1

You can remove the installed *FlexCard* driver package by calling the shortcut in Windows start menu:

Start->Programs->EberspaecherElectronics->FlexCard-> Uninstall FlexCard.

Or:

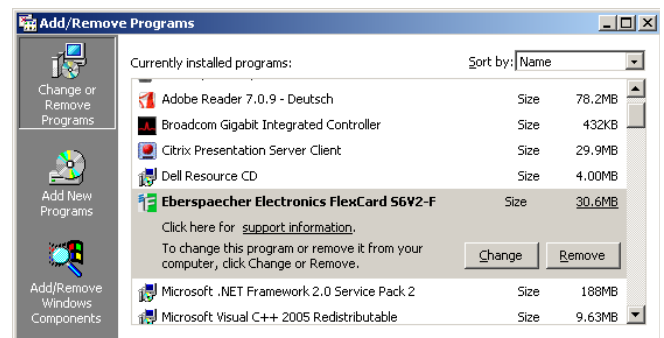
Start->Programs->TZM->FlexCard-> Uninstall FlexCard.

**Uninstall alternative 2**

Another possibility to uninstall the previous *FlexCard* driver package is provided in the Windows Control Panel:

Start->Settings->Control Panel-> Add/Remove Programs

Click "Remove" to uninstall the package.



4.3.4 INSTALLATION ON LINUX OPERATING SYSTEMS

To install the *FlexCard* Linux or Xenomai driver software, please refer to the *Read_Me.txt* file, which can be found in the delivered *FlexCard.zip* file. Before you install the *FlexCard PMC II*, uninstall the old version first.

4.3.5 UNINSTALLATION ON LINUX OPERATING SYSTEMS

To uninstall the *FlexCard* Linux or Xenomai driver, open a terminal and type in the following with super user rights:

```
>> flexcard_stop
```

For Debian based systems use

```
>> dpkg -r libfcBase
```

For Redhat based systems use

```
>> rpm -e libfcBase
```

4.3.6 INSTALLATION/UNINSTALLATION OF THE FLEXCARD LABVIEW DRIVER

Before installing the FlexCard LabVIEW driver, install the FlexCard Windows driver. The further process is described in the FlexCard Family LabVIEW Driver Documentation [6].

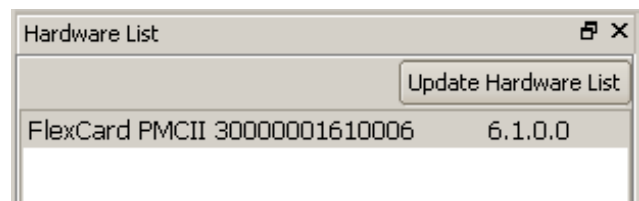
4.4 FIRMWARE UPDATE

In order to update the firmware of a *FlexCard PMC II*, it is necessary to follow these steps.


Step 1

Start the update software *FlexUpdate* included in the *FlexCard PMC II* install package.

In this window, you can check the current hardware and software version of installed *FlexCard* components.



Select the *FlexCard PMC II* whose firmware you want to update from the Hardware List.



The upper right shows details about the selected hardware.

The column “Possible” lists the number of CCs in the firmware. The column “Useable” displays the CCs that are available in the firmware and licensed.

Information

FlexCard PMCI	
Serial	530000001610006
Versions:	
Firmware	6.1.0.0
Hardware	1.1.0.0
BaseDLL	6.1.0.0
DeviceDriver	6.1.0.0
UserCardID (hex)	5

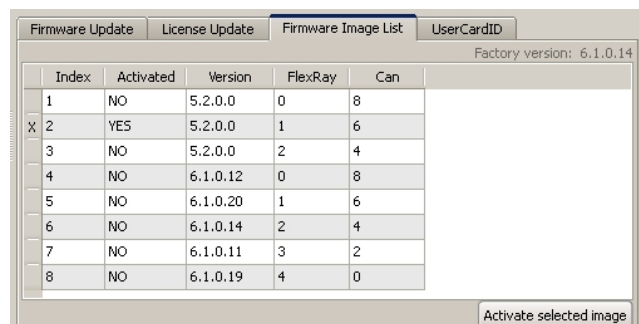
FlexRay	Useable	Possible
CC count	3	3
CC type	Bosch Eray	
Protocol	2.1.0.0	
BusGuardian	---	

CAN	Useable	Possible
CC count	2	2
CC type	Bosch D-CAN	
Protocol	2.0.0.0	

Step 2

Open the tab "Firmware Image List". The *FlexCard PMC II* may store 8 firmware images. You can see on this tab, what images are stored on the *FlexCard PMC II*. For example, when a row contains the values 2, YES, 5.2.0.0, 1, 6, this means: Firmware slot 2 is active at the moment and holds a firmware with 1 FlexRay and 6 CAN CCs and has the version 5.2.0.0. Only one firmware may be active at a time.

Click on a row and then on the button to activate this image. Changes will take effect after a complete computer shut down.



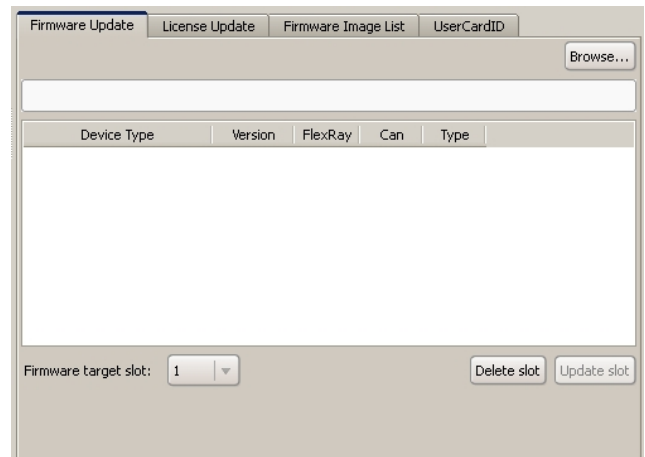


NOTICE

If an empty firmware slot is selected, after a shut down and a system start, the *FlexCard PMC II* will blink with all LEDs on the front panel. Open FlexUpdate and activate a different slot, shut down and start the system again.

Step 3

You may also put different firmware images into the list. Therefore, open the “Firmware Update” tab and click the “Browse” button to select a firmware container file (*.fwf).

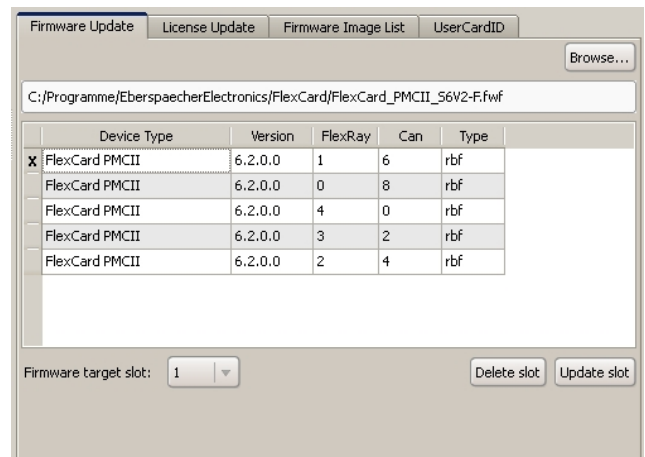


Step 4

The firmware files contained in the firmware container are displayed.

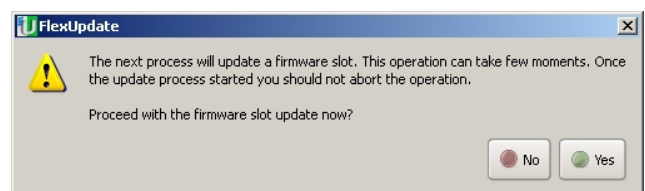
Select the firmware you like to write to the *FlexCard* image list, choose a firmware target slot and click the “Update slot” button.

You also may delete images from the hardware. To do so, select a target slot and click on the “Delete slot” button.



Step 5

Read the warning messages before starting the update process. The process is composed of three phases: **Reset**, **Write** and **Check**.



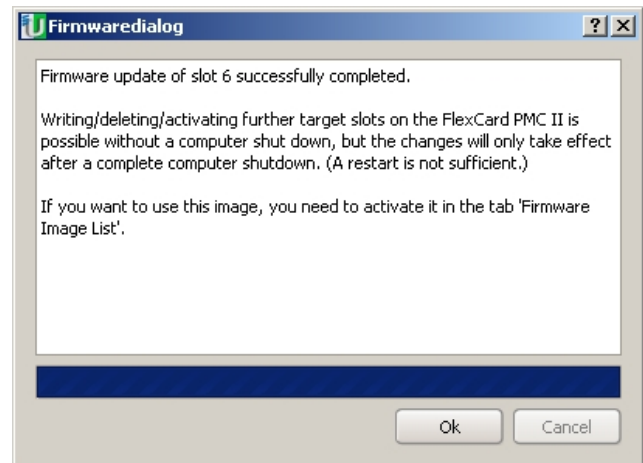
NOTICE

If the firmware update process is disturbed or aborted, the firmware slot will not be able to load.

Step 6

Once the message “**Firmware update of slot X successfully completed.**” appears, close the firmware-update software and shut down the computer or proceed with chapter 4.6. A restart is not sufficient.

After a firmware update stand-by is prevented by the FlexCard driver until the next start of the computer.



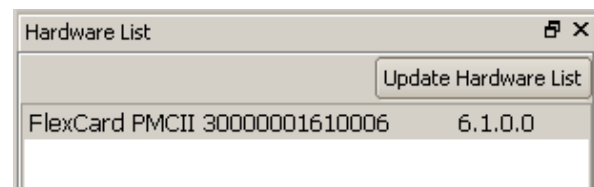
4.5 LICENSE UPDATE


To update the *FlexCard PMC II* with a new license file you need to follow these steps:

Step 1

Insert the *FlexCard PMC II* hardware in the PCI-Slot and start the update software *FlexUpdate* included in the *FlexCard PMC II* install package. In this window, you can check the current hardware and software version of *FlexCard PMC II* components installed.

Select the *FlexCard PMC II* you want to update from the Hardware List.





The upper right shows details about the selected hardware and its currently available features.

The column “Possible” lists the number of CCs in the firmware. The column “Useable” displays the CCs that are available for the application.

Information

FlexCard PMCII		FlexRay		Useable	Possible
Serial	530000001610006	CC count	3		3
Versions:		CC type	Bosch Eray		
Firmware	6.1.0.0	Protocol	2.1.0.0		
Hardware	1.1.0.0	BusGuardian	---		
BaseDLL	6.1.0.0	CAN	Useable		Possible
DeviceDriver	6.1.0.0	CC count	2		2
UserCardID (hex)	5	CC type	Bosch D-CAN		
		Protocol	2.0.0.0		

Step 2

Open the “License Update” tab. On the left side the currently licensed features are displayed.

Click the “Load from file” button to select a license file (*.lic).

Step 3

Once you choose the file, the text on the right side will inform you about the state of the file. The number of licensed FlexRay, FlexRay SelfSync and CAN CCs and the licenses for the LabVIEW, Linux, Windows and Xenomai FlexCard driver are displayed.

If the text “license file ok” appears, you can use “Write License” to apply the license to the hardware.

If not, you need to choose another license file.

Step 4

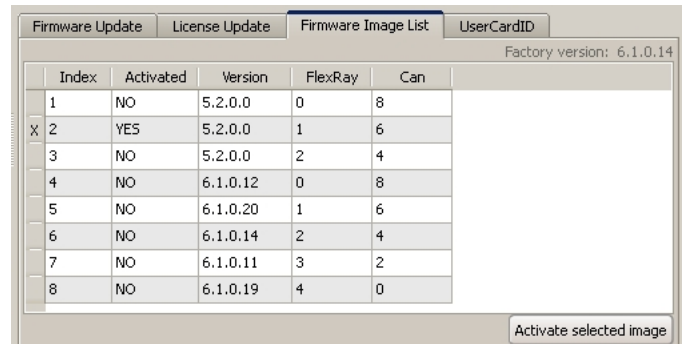
After the license was written, the current licenses on the *FlexCard PMC II* are displayed on the left side.

4.6 ACTIVATE AN APPLICATION IMAGE

Step 1

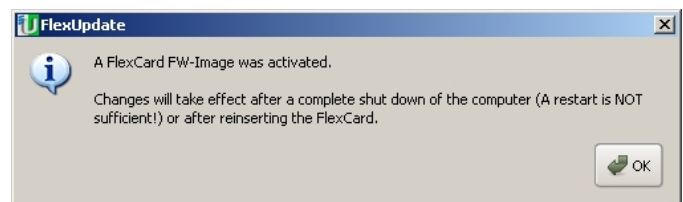
To activate a valid application image open the “Firmware Image List” tab and click the application image index, which will be used after the next system start.

Click the “*Activate selected image*” button.



Step 2

Once the message “**A FlexCard FW-Image was activated.**” appears, close the FlexUpdate and shut down the computer. A restart is not sufficient.

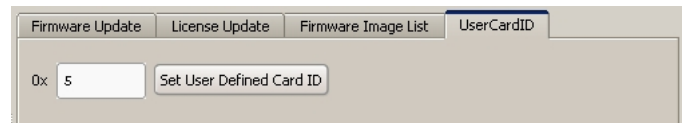


4.7 USERCARDID

Step 1

The UserCardID stays the same even after a computer restart. The purpose is to differentiate between several FlexCards.

Open the UserCardID tab. Enter the new ID and click on the button “*Set User Defined Card ID*”.



Step 2

An entry in the message log states whether the action was successful. The ID is updated in the info list.

FlexCard PMCI		FlexRay	Useable	Possible
Serial	530000001610006	CC count	3	3
Versions:		CC type	Bosch Eray	
Firmware	6.1.0.0	Protocol	2.1.0.0	
Hardware	1.1.0.0	BusGuardian	---	
BaseDLL	6.1.0.0	CAN	Useable	Possible
DeviceDriver	6.1.0.0	CC count	2	2
UserCardID (hex)	5	CC type	Bosch D-CAN	
		Protocol	2.0.0.0	

5 CONFIGURATION AND OPERATION

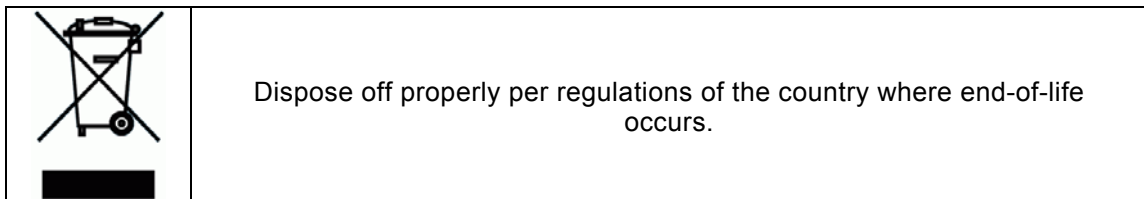
Operation of the *FlexCard PMC II* is described in the user manual of your software vendor. For a description of *Caromee*, refer to [5]. All operation modes as well as information about the programming of a *FlexCard* application are described in the *FlexCard* API Documentation [1].

6 SHIPPING, MAINTENANCE AND DISPOSAL

Keep the package in which the *FlexCard PMC II* was shipped. Store and transport the *FlexCard PMC II* in the ESD foil bag.

Store and transport the *FlexCard PMC II* in a cool, dry, dark environment. Don't store or transport it near sources of magnetic fields.

Void warranty if tried to manipulate/repair the *FlexCard PMC II*. Please contact *Eberspächer Electronics* for maintenance.



7 TROUBLESHOOTING

This chapter contains some frequently asked questions about the *FlexCard PMC II*.

1	Effect	The <i>FlexCard PMC II</i> is not recognized. On Windows, the <i>FlexCard PMC II</i> is not displayed under “Multifunction adapters” in the device manager or it is displayed with a warning symbol in the device manager.
	Cause	<i>FlexCard PMC II</i> is not correctly plugged in. The drivers (respective the INF-file), required by the system to recognize the <i>FlexCard PMC II</i> , are not installed properly.
	Solution	Check if the <i>FlexCard PMC II</i> is inserted correctly. Reinstall the driver for the <i>FlexCard PMC II</i> or update the firmware. Check whether the DLL, SYS and firmware are compatible. The major version numbers must be identical. Use the <i>FlexCard API</i> function “fcbCheckVersion” to test whether DLL, SYS and firmware match. See “ <i>FlexCard API Documentation</i> ”.

2	Effect	No FlexRay frames are received. The <i>FlexCard PMC II</i> could not synchronize with the FlexRay bus (Green LED is blinking).
	Cause	Wrong configuration of the communication controller → the hardware could not synchronize on the FlexRay bus Wrong firmware of the <i>FlexCard PMC II</i> (wrong bus systems chosen). Buses are not correctly terminated. The cable of FlexRay channel A is inserted in plug B and/or vice versa. The FlexTiny II module is missing or the mounted FlexTiny II does not fit to the firmware of the <i>FlexCard PMC II</i> .
	Solution	Check all parameters in the configuration; be sure to use the same configuration as the other FlexRay nodes Ensure that you chose the correct firmware which fits to your needs (regarding FlexRay connections). Terminate your bus systems correctly, for example using the onboard termination. Insert the cables to the correct connectors of the <i>FlexCard PMC II</i> . Mount the correct FlexTiny II module and/or change the firmware. For example if the firmware supports 2 FlexRay channels and 4 CAN channels, install 2 FlexTiny II FR iso on the first two slots and 2 FlexTiny II CAN-HS iso on the last two slots.

3	Effect	No FlexRay frames are received. The <i>FlexCard PMC II</i> is synchronized with the FlexRay bus (Green LED is on).
	Cause	Maybe a filter is activated.
	Solution	Deactivate the message filter and channel filter in the software.

4	Effect	No CAN frames are received.
	Cause	Wrong configuration of the communication controller Wrong firmware of the <i>FlexCard PMC II</i> (wrong bus systems chosen). Bus is not correctly terminated. The FlexTiny II module is missing or the mounted FlexTiny II does not fit to the firmware of the <i>FlexCard PMC II</i> . Maybe a filter is activated.
	Solution	Check the CAN bus parameters on the <i>FlexCard PMC II</i> . Ensure that you chose the correct firmware which fits to your needs (regarding FlexRay connections). Terminate your bus systems correctly, for example using the onboard termination. Mount the correct FlexTiny II module and/or change the firmware. For example if the firmware supports 2 FlexRay channels and 4 CAN channels, install 2 FlexTiny II FR iso on the first two slots and 2 FlexTiny II CAN-HS iso on the last two slots. Deactivate the message filter and channel filter in the software.

5	Effect	The FlexCard API returns with the error "The CC index is not valid".
	Cause	Maybe the license is missing or the wrong firmware is on the FlexCard.
	Solution	Open FlexUpdate and check whether license and firmware are Ok. If the license is missing, please contact Eberspächer Electronics to obtain a license for the bus interfaces.

6	Effect	The FlexCard API returns with the error "Invalid hardware license".
	Cause	The license for using the <i>FlexCard PMC II</i> on this operating system is missing.
	Solution	Please contact Eberspächer Electronics to obtain a license.

7	Effect	All LEDs of the FlexCard PMC II glow red, no messages can be received.
	Cause	The buffer on the FlexCard is full. The data on the FlexCard is collected too slowly by the software.
	Solution	Use a faster PC or filter messages to reduce the workload.

8	Effect	All LEDs on the <i>FlexCard PMC II</i> front panel are blinking.
	Cause	No firmware image could be loaded.
	Solution	Please refer to chapter 4.4 "Firmware Update" on how to write a firmware image into a slot and activate it.

8 ORDERING INFORMATION

8.1 FLEXCARD PMC II

Product	Description	Ordering number
<i>FlexCard PMC II</i>	<p>The <i>FlexCard PMC II</i> is a very flexible hardware solution that offers access to automotive bus systems (FlexRay, CAN).</p> <p>It may be equipped with maximum 4 <i>FlexTiny II</i> modules so that maximum 4 FlexRay interfaces (A+B), maximum 8 CAN interfaces or a combination of are possible.</p>	3-0055-0P01 (Win OS) 3-0055-0P02 (Linux) 3-0055-0P03 (Xenomai)

8.2 ACCESSORY PARTS

Product	Description	Ordering number
<i>FlexTiny II FR iso</i>	The isolated <i>FlexTiny II</i> module allows access to a FlexRay bus. It supports channel A and channel B.	3-0056-0A02
<i>FlexTiny II CAN-HS iso</i>	Allows isolated access to a CAN bus. Two channels are supported.	3-0056-0B02
<i>FlexTiny II FR</i>	The <i>FlexTiny II</i> module allows access to a FlexRay bus. It supports channel A and channel B.	3-0056-0A01
<i>FlexTiny II CAN-HS</i>	Allows access to a CAN bus. Two channels are supported.	3-0056-0B01
FXC FCL8 Cable, 2m length, black	Bus adapter cable between <i>FlexCard PMC II</i> and Sub-D-connector female.	3-0034-1J02
FXC FCL8-2 Cable, 2m length, black	Bus adapter cable for the <i>FlexCard PMC II</i> . Binder 712 to 2 female Sub-D-connectors.	3-0034-1L01
FC Daisy Chain FR 2 Cable, 2m	Connects one male Sub-D and one female Sub-D to the <i>FlexCard PMC II</i> interface 1 and one male and one female Sub-D to interface 2.	3-0034-1Y01
FC Trigger cable BNC, 1m	Trigger cable for <i>FlexCard</i> trigger connector to BNC-plug.	3-0034-0H01
FC Sync cable, 1m	Trigger cable for <i>FlexCard</i> trigger connector to Binder 3-pole.	3-0034-0G01
PMC-to-PCI-adapter	Passive adapter to use a <i>FlexCard PMC II</i> in a standard PC environment.	3-0033-0C01
FlexRay Termination	SubD9 gender changer that terminates one FlexRay interface on the pins used by the <i>FlexCard</i> .	3-0034-0I01

Product	Description	Ordering number
Customer specific parts		Please contact <i>Eberspächer Electronics</i>

8.3 RELATED DOCUMENTS

Document	Description	Ordering number
[1] API Documentation	Describes how to write own applications for the <i>FlexCard</i> family.	3-0009-0S01-D03
[2] <i>FlexCard PMC/PMC II</i> Getting Started	Describes how to use the demo application contained in the Windows <i>FlexCard</i> Installer.	3-0055-0P01-D03
[3] <i>FlexAnalyzerV2</i> Instructions for Use	Explains how to use the monitoring software that is contained in the Windows <i>FlexCard</i> Installer.	3-0038-0B01-D01
[4] <i>FlexConfig</i> User Manual	Manual for the configuration software for FlexRay networks. <i>FlexConfig</i> generates the CHI configuration files used by the <i>FlexCard</i> , <i>FlexXCon</i> and <i>FlexEntry</i> .	3-0016-0C01-D06
[5] <i>Caromee</i> User Manual	Analyzing software that can be easily extended and supports the FlexCard product family.	3-0051-0P01-D03
[6] FlexCard Family LabVIEW Driver Documentation	This document describes how to use the LabVIEW driver with the FlexCard.	3-0072-0A01-D01

9 APPENDIX

9.1 APPENDIX A: GUIDELINE FOR HANDLING ESD SENSITIVE PRODUCTS

- Any tester, equipment, or tool used at any production step or for any manipulation of semi-conductor devices must have its shield connected to ground.
- The product itself and the carrier system of the product respectively must be placed on a conductive table top or covered by an antistatic surface (superficial resistivity equal to or higher than $0.5 \text{ M}\Omega/\text{cm}^2$), grounded through a ground cable (conductive cable from protected equipment to ground isolated through a $1 \text{ M}\Omega$ resistor placed in series).
- All manipulation of finished goods has to be made at such a grounded worktable.
- The worktable must be free of all non-antistatic objects.
- An antistatic floor covering grounded through a conductive ground cable (with serial resistor between 0.9 and $1.5 \text{ M}\Omega$) should be used.
- It is recommended that you wear an antistatic wrist or ankle strap, connected to the antistatic floor covering or to the grounded equipment.
- If no antistatic wrist or ankle strap is worn, touch the surface of the grounded worktable before each manipulation of the ESD sensitive product.
- It is recommended that antistatic gloves or finger coats be worn.
- It is recommended that nylon clothing be avoided while performing any manipulation of parts.

9.2 APPENDIX B:

9.2.1 ACRONYMS AND ABBREVIATIONS

Item	Definition
BD	Bus driver
BG	Bus guardian
BP	Bus plus
BM	Bus minus
CAN	Controller Area Network
CC	Communication Controller
DLL	Dynamic Linked Library
DMA	Direct Memory Access
ECU	Electronic Control Unit
EMC	Electromagnetic Compatibility
ESD	Electro Static Discharge
FR	FlexRay
FW	Firmware
HW	Hardware

Item	Definition
NC	Not Connected
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
PL	Physical Layer
PMC	PCI Mezzanine Card
PXI	PCI eXtension for Instrumentation
SYS	System (Windows low level driver extension)

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