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FlexCard PXIe3 and PCIe3

Instructions for Use

NOTICE	
	ESD (Electro Static Discharge) sensitive product.
	Refer to chapter 1.4 and follow the safety and handling instructions.

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Based on currently state of arts and science it is impossible to develop software that is bug-free in all applications. Therefore, the product is only allowed to be used in the sense of the product use case described herein.

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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 PXIe3/PCIe3 complies with the essential requirements of the following applicable European Community Directive(s) including current amendments, and carry the CE marking accordingly:

> ➢ 2014/30/EU EMC Directive

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

> ➢ EN 61000-4-2:2009
> ➢ EN 61000-4-3:2006 + A1:2008 + A2:2010
> ➢ EN 61000-4-4:2012
> ➢ EN 61000-4-5:2014 + A1:2017
> ➢ EN 61000-4-6: 2014
> ➢ EN 61000-6-2:2005
> ➢ EN 61000-6-3:2007 + A1:2011 (FlexCard PCIe3 only)
> ➢ EN 61000-6-4:2007 + A1:2011 (FlexCard PXIe3 only)
> ➢ EN 61326-1:2013

The FlexCard PXIe3 is a Class A product. Using the product in domestic environment may lead to electromagnetic disturbances.

This product is compliant with the European Community Directive 2011/65/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

UK Conformity

The FlexCard PXIe3/PCIe3 complies with the essential requirements of the following applicable UK Regulations including current amendments, and carries the UK marking accordingly:

> ➢ 2016 Electromagnetic Compatibility Regulations

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

> ➢ EN 61000-4-2:2009
> ➢ EN 61000-4-3:2006 + A1:2008 + A2:2010
> ➢ EN 61000-4-4:2012
> ➢ EN 61000-4-5:2014 + A1:2017
> ➢ EN 61000-4-6: 2014
> ➢ EN 61000-6-2:2005
> ➢ EN 61000-6-3:2007 + A1:2011 (FlexCard PCIe3 only)
> ➢ EN 61000-6-4:2007 + A1:2011 (FlexCard PXIe3 only)
> ➢ EN 61326-1:2013

The FlexCard PXIe3 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 Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012".

Revision History

Document number: 3-0094-0A01-D10

Version	Date	Description
D1V0-3	06-Jun-2019	Preliminary version
D1V0-5	04-Nov-2019	Preliminary version: updated description for DIO
D1V0-12	09-Jun-2020	Preliminary version: added FlexCard PCIe3
D1V0-F	21-Jun-2021	First Release
D1V0a-F	21-Jun-2021	Added information about low-active trigger lines in FlexCard mode
D1V1a-F	06-Oct-2021	Added info about the FPGA images. Added information about the Operating Modes.
D1V2-F	15-Feb-2022	Updated chapter EC Conformity Added chapter UK Conformity

Related Hardware / Software Versions

Product	Reference No.	Version	Remarks
FlexCard PXIe3 hardware	3-0094-0B01	50	
FlexCard PCIe3 hardware	3-0095-0B01	20	

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1 General

1.1 Intended User Group

This product may only be used by expert technicians and/or engineers who are qualified and familiar with electronic components and systems.

Each person involved with setup or operation of the product must

 ➢ be a qualified technician or engineer

 ➢ strictly adhere to this manual

 ➢ receive a briefing by an authorized person

	NOTICE
ⓘ	If you are unsure of how to use the product as intended or have any questions about the use of the product, please discontinue use of the product immediately and contact the STAR ELECTRONICS GmbH & Co. KG Support.

	⚠ WARNING
⚠	The product may only be used by expert technicians and/or engineers who are qualified and familiar with electronic components and systems! The use of the product by non-professionals is not permitted and strictly forbidden!

1.2 Intended Use

The FlexCard PXIe3/PCIe3 is a testing equipment. It was developed to test the communication behavior of automotive bus systems and Ethernet together with Electronics Control Units and sensors in a fully controlled testing and/or laboratory environment.
For this intended use, the FlexCard PXIe3/PCIe3 offers the following options:

- Transmit and receive data (e.g. Use Case "Remaining Bus Simulation").

- Exchange of data traffic between two or more bus systems (e.g. Use Case "Gateway")

- Manipulation of data traffic (e.g. Use Case "Manipulation of signal values based on user configuration")

- Recording of data traffic (e.g. Use Case "Logging")

Any deviation from the intended use and/or installation in a testing vehicle is only permitted with specific **prior written approval** of STAR ELECTRONICS GmbH & Co. KG.

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<table>
<tr>
<td rowspan="4">⚠️</td>
<td>⚠️ **WARNING**</td>
</tr>
<tr>
<td>The FlexCard PXIe3/PCIe3 may be used to communicate with networked electronic systems. E.g. FlexRay, CAN or Ethernet.</td>
</tr>
<tr>
<td>Any use of the product outside a fully controlled testing and/or laboratory environment may result in death or serious injury due to unpredictable behavior of a vehicle and/or potentially missing, deactivated, or malfunctioning safety devices on a vehicle!</td>
</tr>
<tr>
<td>The user is responsible to ensure the safety of the entire system. This includes amongst other things a safety shutdown.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">❗</td>
<td>**NOTICE**</td>
</tr>
<tr>
<td>The device is not a calibrated measurement device. STAR ELECTRONICS GmbH & Co. KG accepts no liability whatsoever for the correctness of any measurement results.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">⚠️</td>
<td>⚠️ **WARNING**</td>
</tr>
<tr>
<td>The FlexCard PXIe3/PCIe3 is **NOT** designed, intended, or authorized and may **NOT** be used for or in connection with the following purposes and/or devices:

- 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

- any other purposes / devices deviating from the intended use of the product specified by STAR ELECTRONICS GmbH & Co. KG.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">⚠️</td>
<td>⚠️ **WARNING**</td>
</tr>
<tr>
<td>The product may only be used by expert technicians and/or engineers who are qualified and familiar with electronic components and systems!

The use of the product by non-professionals is not permitted and strictly forbidden!</td>
</tr>
</table>

1.3 Used Pictograms

The meaning of used pictograms is shortly described below.

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

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

📖	**Reference**
	References to other documents.

🗑️	
	Product marking which shows the compliance of the product with the European Waste Electrical and Electronic Equipment Directive 2012/19/EU.

1.4 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 PXIe3/PCIe3 has to be handled as described herein.

Changes or modifications of the FlexCard PXIe3/PCIe3 is not allowed for safety and warranty reasons!

*STAR ELECTRONICS GmbH & Co. KG i*s not liable for any damages arising from non-observance of the product information.

Follow the
a) specific safety and handling instructions placed at dedicated document positions
b) general safety and handling instructions below:

🛈	**NOTICE**
	To prevent damage to the FlexCard PXIe3/PCIe3, or consequential damages:
	Use only adapter cables from *STAR ELECTRONICS GmbH & Co. KG* for connecting the FlexCard PXIe3/PCIe3.
	High temperatures can damage the FlexCard PXIe3/PCIe3. Keep the FlexCard PXIe3/PCIe3 away from heaters, stoves, fireplaces, and other sources of heat.
	Do not expose the FlexCard PXIe3/PCIe3 to rain or use it near water.
	Do not use the FlexCard PXIe3/PCIe3 in areas of explosion hazard.

🛈	**NOTICE**
	To prevent irreversible damages to the FlexCard PXIe3/PCIe3:
	Avoid any direct current flow through the housing of the device or the shield of the Binder connectors!
	Do not connect any other signals to the interfaces as described in the chapter 8.2 Accessory Parts. Ensure that all signals are within the specified range.
	Attention: The warranty is lost if the device is damaged by not avoiding such current flow or connecting any signals which are out of range.

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	NOTICE
	ESD (Electro Static Discharge) sensitive product
	STAR ELECTRONICS GmbH & Co. KG products lacking protective enclosures are subject to damage by ESD.
	Take proper ESD precautions to avoid performance degradation or loss of functionality!
	Unpack, handle or operate these products only in environments where sufficient precautionary measures have been taken in respect to ESD hazards. A guideline is available in chapter 9.1.
	Only appropriately trained personnel (such as electricians, technicians and engineers) may handle and/or operate these products.

1.5 Meaning of Text Styles

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

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2 Product Description

2.1 FlexCard PXIe3/PCIe3 at a glance

The multifunctional bus control unit FlexCard PXIe3/PCIe3 support multiple current and upcoming bus systems and has numerous variable interfaces, so it covers most of the application fields where bus interfaces are required. This device is appreciated by embedded software developers since it facilitates the implementation and testing of even sophisticated gateway applications and prototyping functionalities.

Field of application

- Analyzing of bus data
- Vehicle diagnostics
- Remaining bus simulation
- Gateways between different automotive bus systems
- Signal manipulation
- Data logging
- Rapid prototyping

Technical Features FlexCard PXIe3/PCIe3

- Altera Cyclone V SOC (integrated ARM Cortex A9 dual core CPU)
- DDR3 RAM 1 GByte
- 5 bus connectors with pluggable transceivers
- Up to 4 FlexRay controllers (4 Bosch E-Ray cores)
- Up to 8 FlexRay channels (4 channel A and 4 channel B) available on the connectors
- In each case 2 FlexRay cores can be connected internally (self-synchronization)
- Up to 10 CAN-HS bus interfaces
- Up to 10 CAN-FD bus interfaces
- Wakeup/sleep-support for bus transceiver (wakeup possible via FlexRay or CAN or local wakeup via DIO)
- Up to 7 100 MBit/s Ethernet bus interfaces
- Up to 7 100BASE-T1 bus interfaces
- 2 digital inputs or outputs (switchable between 5 V highspeed and 5/55 V high voltage resistance)

2.2 Accessory Parts

For usage of the FlexCard PXIe3/PCIe3, the following parts are necessary (not included in delivery):

- for the FlexCard PXIe3 a PXIe Rack
  or
  for the FlexCard PCIe3 a PC with PCIe interface
- Application software, e.g. FlexConfig RBS running under Windows 10 or Linux version

For further information about accessories for the FlexCard PXIe3/PCIe3 see chapter 8.2 Accessory Parts.

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	NOTICE
ⓘ	Use only accessories from *STAR ELECTRONICS GmbH & Co. KG* listed in chapter 8.2 with the FlexCard PXIe3/PCIe3 to ensure proper function and for warranty reasons! Other accessories without prior written consent of *STAR ELECTRONICS GmbH & Co. KG* must not be used.

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3 Technical Data

3.1 Electrical Characteristics

	Min.	Typ.	Max.
Supply current PXI system			
Operating 12V		150 mA	500 mA
Operation 5.0Vaux		250 mA	500 mA
Operation 3.3V		550 mA	1200 mA
Supply current PCI system			
Operating 12V		150 mA	500 mA
Operation 3.3V		750 mA	1200 mA
Operation 3.3Vaux		100 mA	250 mA
The timings in this table are hardware specific and include no software timings!			
DIO (Output) FlexDevice mode (high voltage resistance)			
Turn-on time (IN = high) V_s = 5V, R_{LOAD} = 2k, V_{LOAD} = 12V, time to 90% I_{LOAD}	-	2 µs	8 µs
Turn-off time (IN = low) V_s = 5V, R_{LOAD} = 2k, V_{LOAD} = 12V, time to 10% I_{LOAD}	-	2 µs	8 µs
DIO (Input) FlexDevice mode (high voltage resistance)			
Operating mode high (ampl. factor 11/1)			
- high level detection	+24.0 V	-	+55.0 V
- low level detection	0.0 V	-	+12.0 V
Operating mode low (ampl. factor 1/1)			
- high level detection	+2.2 V	-	+5.0 V
- low level detection	0.0 V	-	+1.7 V
Absolute maximum (low and high) (non-operating)	-48.0 V	-	+60.0 V
DIO analog mode (Input) FlexDevice mode			
Operating mode high (ampl. factor 11/1)	0.0 V	-	+55.0 V
Operating mode low (ampl. factor 1/1)	0.0 V	-	+5.0 V
Absolute maximum (low and high) (non-operating)	-48.0 V	-	+60.0 V
DIO (Output) FlexCard mode (high-speed)			
5V Turn-on time	-	10 ns	40 ns
0V Turn-off time	-	10 ns	40 ns
DIO (Input) FlexCard mode (high-speed)			
high level detection	+2.0 V	-	+5.5 V
low level detection	0.0 V	-	+0.8 V
Absolute maximum (low and high) (non-operating)	-0.5 V	-	+6.5 V

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	Min.	Typ.	Max.
5V Turn-on time	-	100 ns	180 ns
0V Turn-off time	-	100 ns	180 ns

Table 1: Electrical characteristics

3.2 Physical Characteristics

Connectors	
DIO 1 – 2	MMCX – 1 pol.
Con 1 – 5	Binder series 702/712 – 8 pol.
Mounting position	Mechanical limitations: none Electrical limitations: none Temperature limitations: none
Weight approx., without FlexTiny	180 g
FlexCard PXIe3: Dimensions approx. L x W x H (including connectors, including slot metal plate, including the ejection lever)	210 mm * 130 mm * 3U
FlexCard PCIe3: Dimensions approx. L x W x H (including connectors, including slot metal plate)	172 mm * 125 mm * 18 mm

Table 2: Physical characteristics

3.3 Environmental Conditions

	NOTICE
	ATTENTION: An over temperature may damage the FlexCard PXIe3/PCIe3, if the temperature is higher than the allowed 70°C!

Temperature (FlexCard PXIe3)	Operating: -20°C – +70°C Non-operating: -40°C – +85°C Storage: -40°C – +85°C
Temperature (FlexCard PCIe3)	Operating: -40°C – +70°C Non-operating: -40°C – +85°C Storage: -40°C – +85°C
IP-Code	None
Relative Humidity	0% – 90% r. H., non-condensing
Vibration resistance (for FlexTiny relay)	Destruction: 10 – 55 Hz (Double amplitude of 5 mm) Functional: 10 – 55 Hz (Double amplitude of 3.3 mm, detection time: 10 µs)
Shock resistance (for FlexTiny relay)	Destruction: 1,000 m/s^2 (Half-wave pulse of sine wave: 6 ms.) Functional: 750 m/s^2 (Half-wave pulse of sine wave: 6 ms; detection time: 10 µs.)

Table 3: Environmental conditions

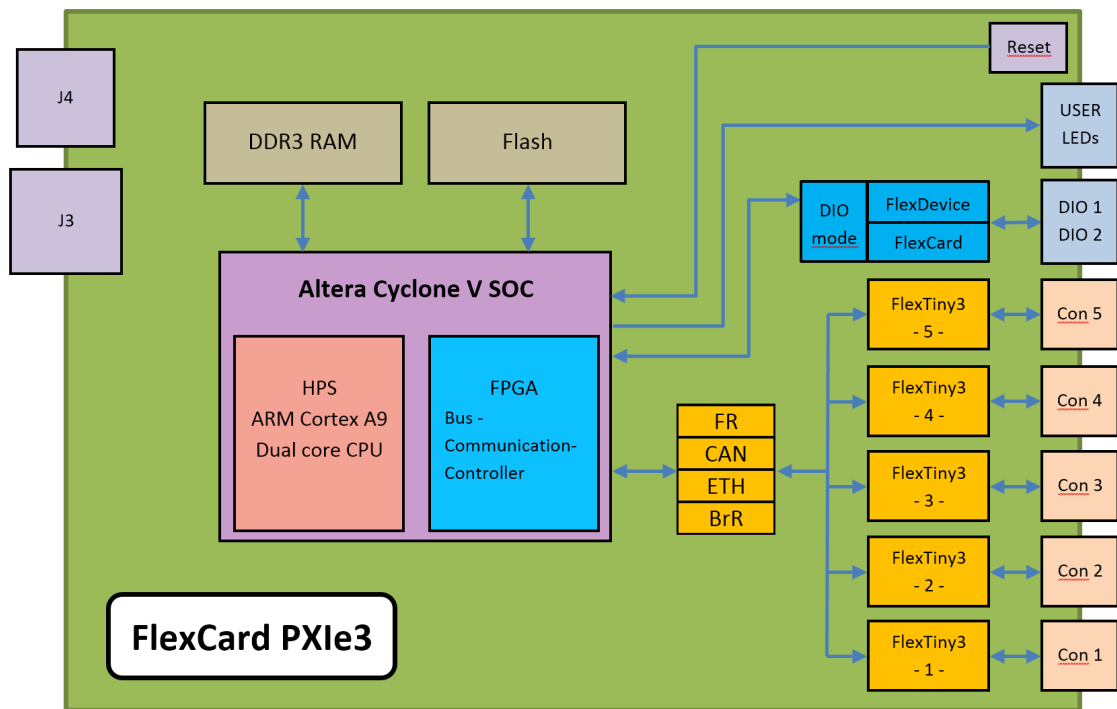## 3.4 Block Diagram

Functional overview of the FlexCard PXIe3/PCIe3

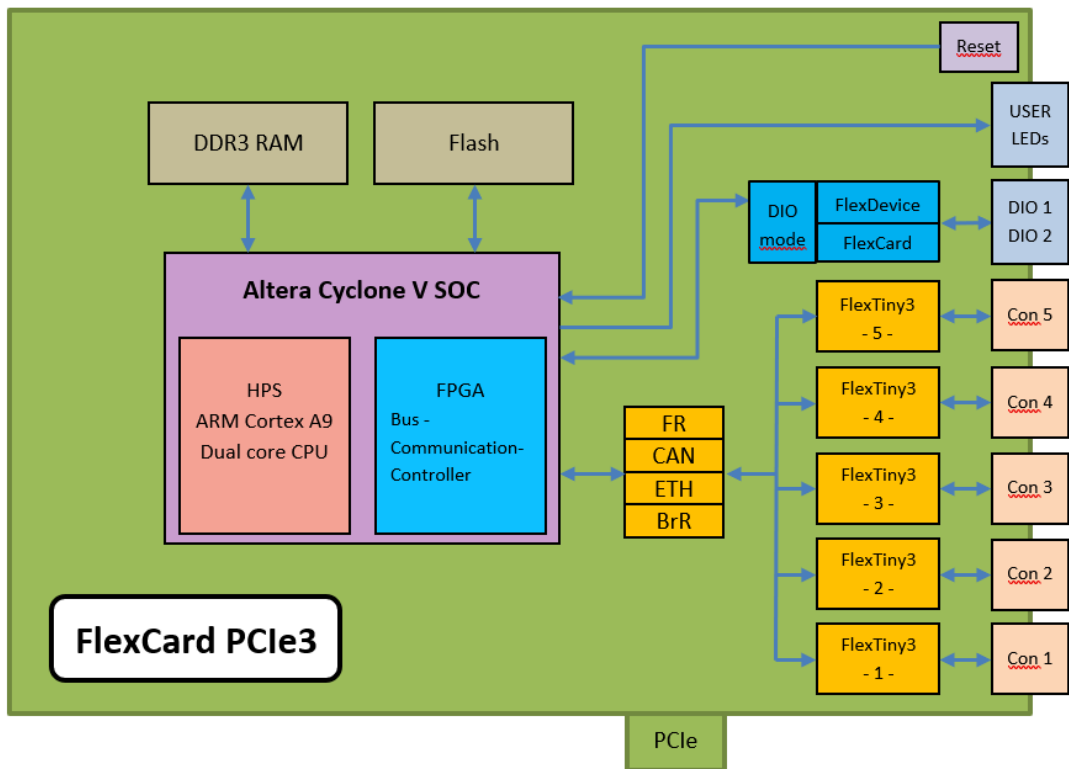| Created by	STAR ELECTRONICS GmbH & Co. KG			
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Figure 1: Block diagram of FlexCard PXIe3

Figure 2: Block diagram of FlexCard PCIe3

3.5 Interfaces

3.5.1 Power FlexCard PXIe3

The FlexCard PXIe3 uses the 12 V, 3.3 V and 5.0 Vaux from the PXIe Rack.

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The 5.0 Vaux is used in case of power saving. Some bus transceivers support an UBAT supply input that supplies the bus drivers in sleep mode. The respective UBAT supply pin of the bus driver ICs is connected to the permanent supplied voltage.

3.5.2 Power FlexCard PCIe3

The FlexCard PCIe3 uses the 12 V, 3.3 V and 3.3 Vaux from the PCIe PC.

The 3.3 Vaux is used in case of power saving. Some bus transceivers support an UBAT supply input that supplies the bus drivers in sleep mode. The respective UBAT supply pin of the bus driver ICs is connected to the permanent supplied voltage.

3.5.3 Digital In/Output (DIO) (FlexDevice Mode)

The FlexCard PXIe3/PCIe3 can get or set digital signals like a FlexDevice-S or L in the DIO FlexDevice mode

	NOTICE
	A relay switch between the FlexCard mode and the FlexDevice mode. Be careful when switching from FlexDevice mode to FlexCard mode while signals are connected.

A dual Low-Side-Switch BTS3408 from Infineon drives the digital output of the FlexCard PXIe3/PCIe3. Connect the load between the supply voltage and the DIO[x] pin. The BTS3408 is a 60 V with 550 mA switch.

For each channel, a 100 kOhm resistor in series to the input from a rail-to-rail operational amplifier (OP) LT1490 from Analog Device protects the digital inputs of the FlexCard PXIe3/PCIe3. This OP is internally protected from -18.0 to 44.0 V. To expand the range from input from 5.0 to 55.0 V a controllable 11/1 voltage divider is implemented in the FlexCard PXIe3/PCIe3. The propagation delay of the input signal to the processor is >15 µs.

The following figure shows the functional overview of the DIO in/output logic in the FlexDevice mode
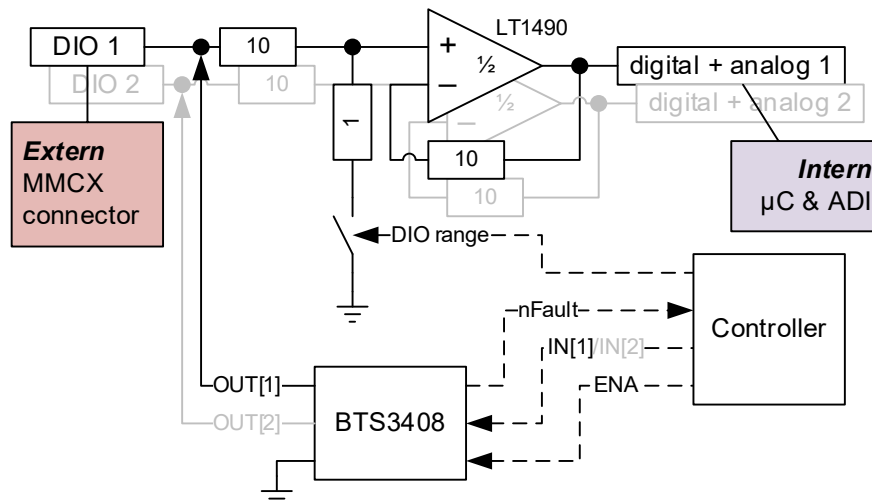

Figure 3: FlexDevice mode DIO in-/output internal overview

NOTICE
The DIO output is **NOT** a push/pull driver, it can only pull down the signal.
Put the load (LED, resistor, motor, etc.) between a positive power supply (V_{bb}) and the DIOx pin from the FlexCard PXIe3/PCIe3

The following figure is the block diagram for the BTS3408 out of the datasheet. The BTS3408 has two channels, IN1 drives OUT1 and IN2 drives OUT2. EN enables both outputs.
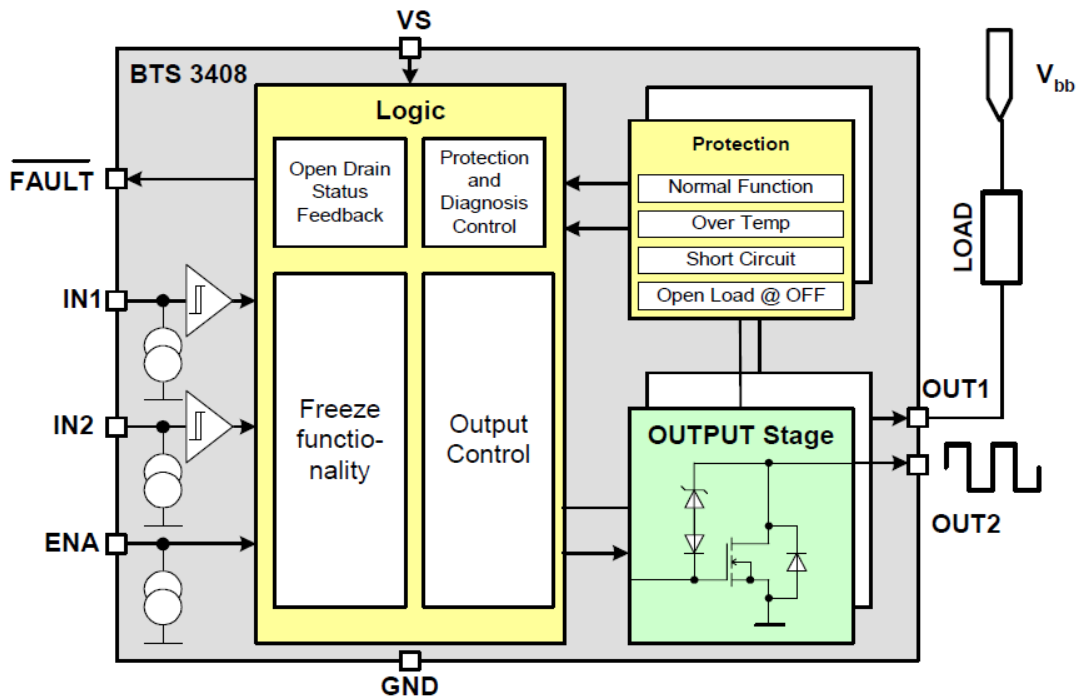

Figure 4: DIO output BTS3408 functional block diagram

Connector	Pin	Name / Function	Range		
			NOTICE		
	Case	DIO_GND	Digital ground		
DIO MMCX 1 contact	1	DIO[1/2] Digital in/output or analog input	Operating: 0.0 – +5.0/55.0 V Switching thresholds: (operating at 0 – +5 V): +2.2 V (operating at 0 – +55 V): +24 V Absolute Maximum: FlexDevice Mode: -48 – +60 V **FlexCard Mode: -0.5 – +6.0 V**		

Table 4: DIO connector electrical specification in FlexDevice mode

3.5.4 Digital In/Output (DIO) (FlexCard Mode)

For synchronization purposes in FlexCard mode, the FlexCard PXIe3/PCIe3 provides two 5V tolerant TTL-compatible trigger connectors (DIO[1] and DIO[2]) on the front panel.

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NOTICE
A relay switch between the FlexCard mode and the FlexDevice mode. Be careful when switching from FlexDevice mode to FlexCard mode while signals are connected. The signals must be between 0.0 V and 5.0 V!

The FlexCard PXIe3/PCIe3 could receive and generate trigger events on both trigger connectors. This feature allows e.g. a synchronization of different bus analyzing devices.

Physically, the triggers are MMCX-male-connector for coax-cables. The electrical characteristic of this output is described in Table 5. In output direction the trigger line is low active. When a pulse is generated, the output voltage drops from 5V to 0V, stays 0V for 8 microseconds and then returns back to 5V.

Connector	Pin	Name / Function	Range	
DIOx MMCX 1 contact			**NOTICE**	
	Case	DIO_GND		Digital ground
	1	DIO[1/2] Digital in/output or analog input		Operating: 0.0 – +5.0 V Input high voltage: +2.4 V Input low voltage: +0.8 V Absolute Maximum: **FlexCard Mode: -0.5 – +6.0 V** FlexDevice Mode: -48 – +60 V

Table 5: DIO connector electrical specification in FlexCard Mode

Reference
Detailed information about how the trigger events are used with the FlexCard PXIe3/PCIe3 can be found in the FlexCard API Documentation.

3.5.5 Digital In/Output (DIO) connector und LEDs

Between the two DIO connectors are two pairs of yellow and blue LEDs for visualization of user states or debugging purposes. For more information about the FlexCard PXIe3/PCIe3 DIO LEDs refer to the manual of the used application (e.g. FlexConfig RBS).
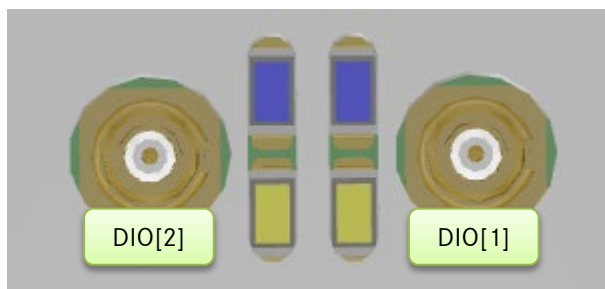

Figure 5: DIO connectors with LEDs

Connector DIO		
Pin	**Signal Name**	**Description**
1	DIO[1/2]	Digital 1/2 in/output
Case	Ground	Ground

Table 6: Pinout DIO connector

3.5.6 Bus Interfaces (Con 1 – 5)

!	**NOTICE**
	To prevent any ESD damage to the device, the allowed maximum cable length for the bus interfaces is 30m!

The FlexCard PXIe3/PCIe3 has five bus interface connectors. Each connector includes different buses depending on mounted FlexTiny III module. Possible FlexTiny III variants are FlexRay, CAN-FD, LIN/SENT, ETH-switched (100MBit) or 100BASE-T1. For detailed information, see chapter 3.5.7 FlexTiny 1 – 5 Interfaces (Inside) and 8.2 Accessory Parts.

The connectors are labeled with their corresponding number (see figure below). The connector next to Con 1 is Con2 and so on. Below every connector is a pair of two LEDs, a green and a red LED for visualization of user states or debugging purposes. The right LEDs shows channel[A] the left LEDs shows channel[B]. For more information about the LEDs refer to manual of the used application (e.g. FlexConfig RBS).
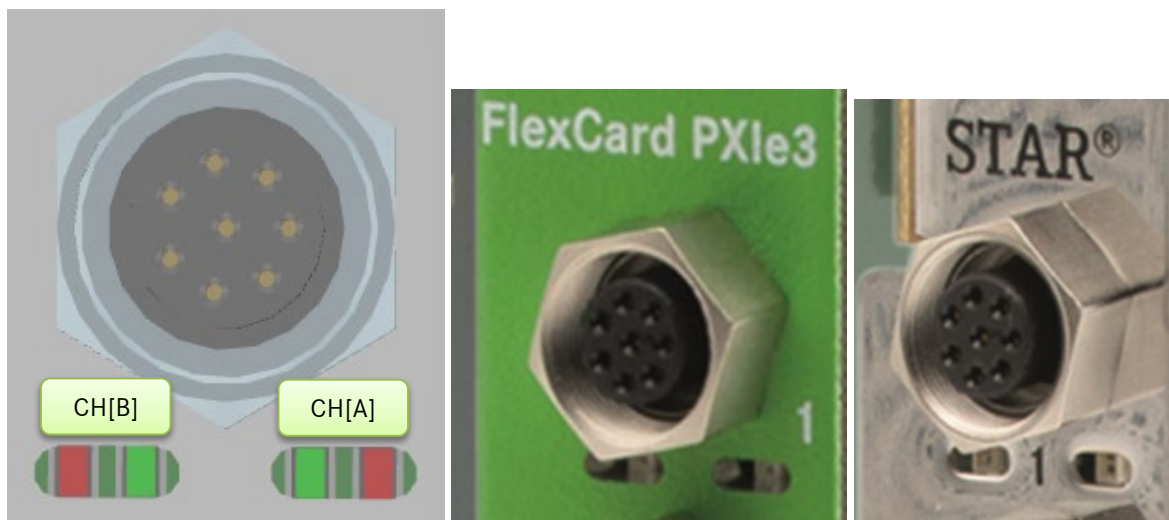

Figure 6: Con 1 – 5 connectors

📖	**Reference**
	The pinout from the connector depends on the mounted FlexTiny III module. See the document Instructions for Use FlexTiny3 [1] for more information.

3.5.7 FlexTiny 1 – 5 Interfaces (Inside)

The FlexCard PXIe3/PCIe3 has five FlexTiny III module interface connectors. Each slot supports different FlexTiny III modules. Possible types are: FlexRay, CAN-FD, LIN/SENT, ETH-switched (100MBit) or 100BASE-T1. For other interfaces contact *STAR ELECTRONICS GmbH & Co. KG.*

If necessary, it is possible to change the equipped FlexTiny III modules to different variants. Before changing FlexTiny III modules, unmount the FlexCard PXIe3/PCIe3 from the rack or PC to make sure that it is unpowered.

The Ethernet and 100BASE-T1 FlexTiny III need a full interface for a two-channel functionality, which is only available for the sockets 2 and 4. The sockets 1, 3 and 5 support only one channel.

The following figure and table show the features of each Tiny slot.

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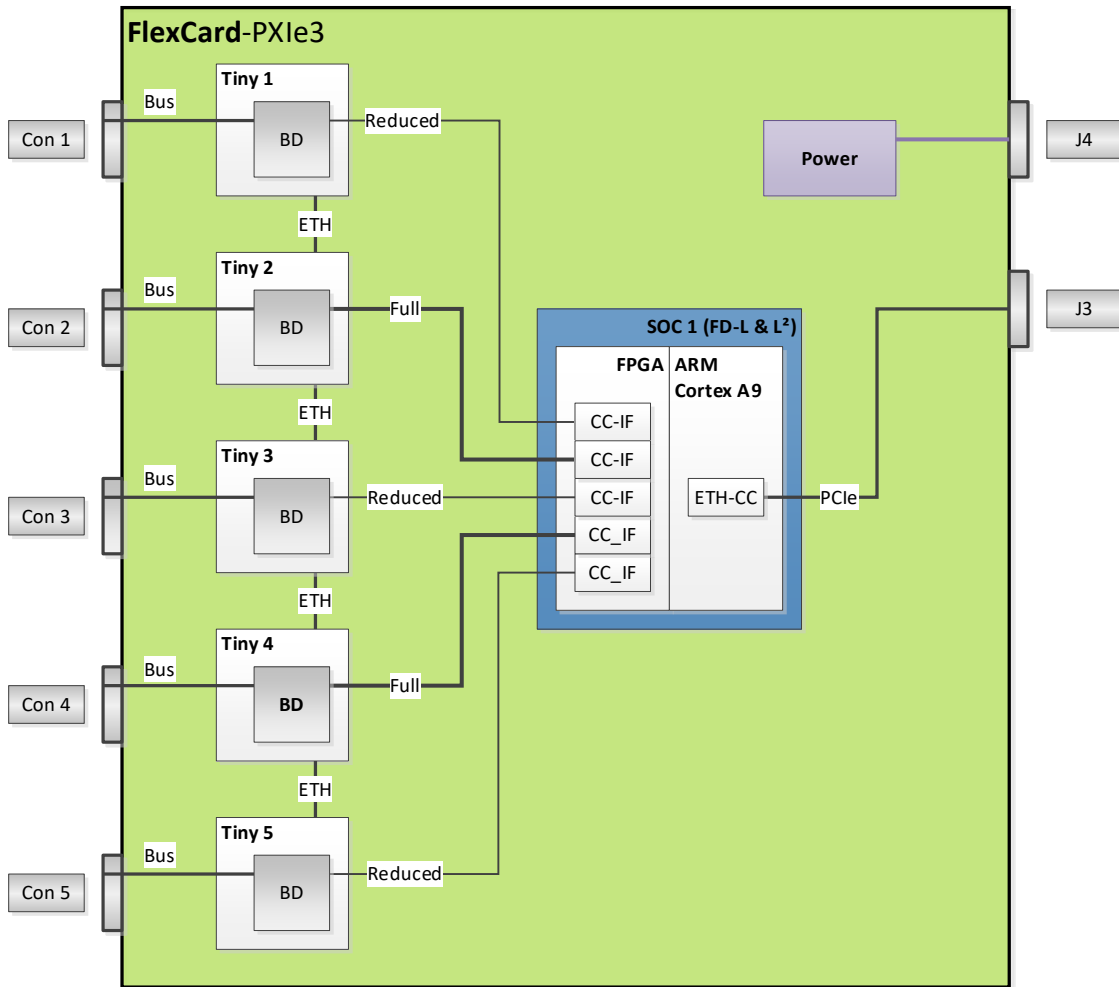3-0094-0A01-D10_Instructions_for_Use_FlexCard_PXIe3_and_PCIe3_D1V2-F.docx

Figure 7: FlexTiny III interface 1 – 5 overview (the FlexCard PXIe3 is shown, the FlexCard PCIe3 is similarly)

The size of the bus in the above figure depends on the used Tiny, 8 signal lines are available.

FlexTiny III	Transceiver	Socket 1	Socket 2	Socket 3	Socket 4	Socket 5
LIN/SENT	TJA1021	All Ch.	All Ch.	All Ch.	All Ch.	All Ch.
CAN FDx4	NXP TJA1044G	4 Ch.	4 Ch.	4 Ch.	4 Ch.	4 Ch.
CAN FD	NXP TJA1081B	2 Ch.	2 Ch.	2 Ch.	2 Ch.	2 Ch.
FlexRay	NXP TJA1145T/FD	2 Ch.	2 Ch.	2 Ch.	2 Ch.	2 Ch.
100 Mbit Ethernet	Marvell 88E6350R	1 Ch.	2 Ch.	1 Ch.	2 Ch.	1 Ch.
100BASE-T1	Broadcom BCM89810	1 Ch.	2 Ch.	1 Ch.	2 Ch.	1 Ch.
1000BASE-T1	Marvell 88Q2112	1 Ch.	2 Ch.	1 Ch.	1 Ch.	1 Ch.

Table 7: FlexTiny III interface 1 – 5 supported channels for FlexCard PXIe3/PCIe3

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	NOTICE
ⓘ	• To ensure proper function and for warranty reasons change FlexTiny III modules only in ESD safe areas by yourself. Before changing FlexTiny III modules, unmount the FlexCard PXIe3/PCIe3 from the rack/PC to make sure that it is unpowered. • Vibration resistance Destruction: 10 – 55 Hz (Double amplitude of 5 mm) Functional: 10 – 55 Hz (Double amplitude of 3.3 mm, detection time: 10 μs.) • Shock resistance Destruction: 1,000 m/s² (Half-wave pulse of sine wave: 6 ms) Functional: 750 m/s² (Half-wave pulse of sine wave: 6 ms, detection time: 10 μs.) • Some FlexTiny III types have a mounted relay. The relay state is set on each power-on.

The positions of the Tiny X slots are marked on the PCB and correspondence with the connector marking Con X.
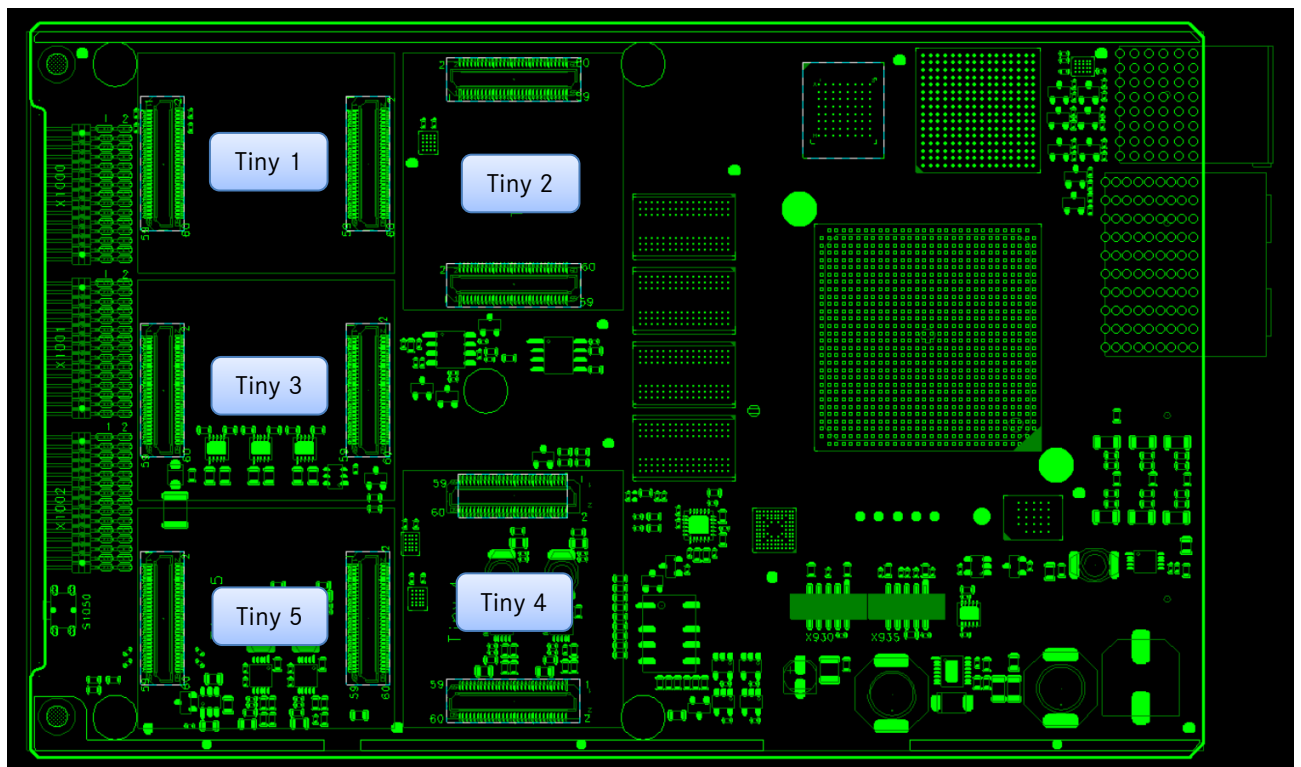

Figure 8: FlexTiny III slots 1 – 5 on the FlexCard PXIe3/PCIe3 PCB (the PXIe3 is shown, the PCIe3 is similarly)

	NOTICE
ⓘ	Check the correct direction from the FlexTiny module before inserting in the FlexTiny slot! Tiny 2 and 4 are turned 180°! The five FlexTiny III can be fixed with a FlexTiny fixation unit which is fixed with five 2.5 x 6 mm screws. This unit is available from STAR ELECTRONICS GmbH & Co. KG see chapter 8.2.

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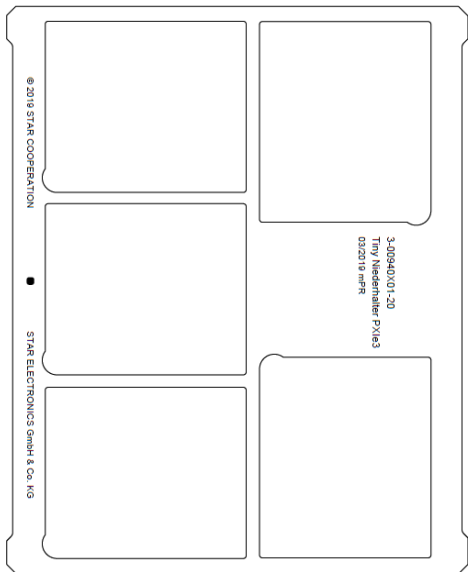Figure 9: FlexTiny fixation unit for the FlexCard PXIe3/PCIe3

3.5.8 Reset Button and USER LEDs

In case of malfunction or a required reset of the FlexCard PXIe3/PCIe3, it is possible to reset the FlexCard PXIe3/PCIe3 and load the Factory Image. A button is located at the front panel behind the small opening and must be pressed with a small nonmetallic tool for more than 4 seconds to initiate a reset. For more information about the reset procedure, refer to chapter 3.5.9.

Above the reset opening there are five LEDs (green, yellow, red, blue and white) for visualization of user states or debugging purposes. For more information about the LEDs refer to the manual of the used application (e.g. FlexConfig RBS).
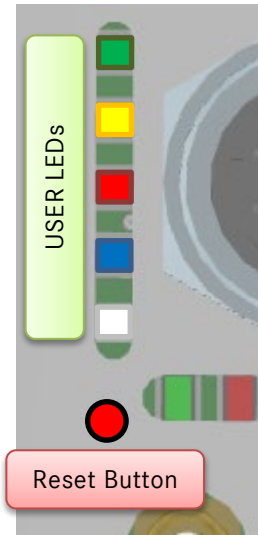
Figure 10: Button and USER LEDs

⚠️	**NOTICE**
	After a reset of the FlexCard PXIe3/PCIe3, the user application is not available anymore. It is necessary to flash a new user application to the FlexCard PXIe3/PCIe3.

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!	**NOTICE**
	After a reset of the FlexCard PXIe3/PCIe3 it is not accessible in Windows. A Windows restart is required.

3.5.9 Factory Image

If a reset is initiated (see chapter 3.5.8 Reset Button), the FlexCard PXIe3/PCIe3 will set the parameters and settings to default values and load the Factory Image. The changed parameters after loading the Factory Image can be found in Table 8.

The FPGA image for the mode "Mixed Mode" is loaded. See chapter 4.4.

After the reset procedure, the blue user LED and the blue DIO[1] LED are blinking.

The IP address from this table is not used to reach the device. Instead, use the IP address from the WebAdmin UI (see chapter 5.1).

Changed parameters and settings after loading the Factory Image	
Parameter / Setting	**Factory Image value**
Device name (FlexCard PXIe3)	FlexCard PXIe3
Device name (FlexCard PCIe3)	FlexCard PCIe3
IP Address (ethernet, not PCIe!)	192.168.1.15
IP Port	1500
Subnet Mask	255.255.255.0
Standard Gateway	192.168.1.1
Project name	Factory Image
Termination	Disabled for all channels
Wakeup/Sleep	Disabled for all channels
Software Sleep	Disabled

Table 8: Changed parameters and settings after loading the Factory Image

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4 Getting Started

4.1 Assembly and Line-up

Read and follow these instructions when connecting and using the FlexCard PXIe3/PCIe3:

	NOTICE
ⓘ	Ensure that all signal lines connected to the FlexCard PXIe3/PCIe3 are in the allowed range.
	Be sure to connect all cables as described in this manual.
	Never insert anything metallic into the openings of the front panel of the FlexCard PXIe3/PCIe3.
	Ensure to grasp the plug and not the cable when disconnecting the FlexCard PXIe3/PCIe3.

4.1.1 Bus termination examples

Several automotive bus systems need a proper line termination. Here are examples how to terminate a FlexRay network.

4.1.2 Point-to-Point Bus Interface Connections

When the FlexCard PXIe3/PCIe3 is connected to an existing network, the best way is a point-to-point connection, if necessary with an Active-Star. The point-to-point method offers the best signal integrity. Transmitted signals go from the transmitter to the Active-Star device, which forwards the signals to all other devices. All devices in the network should be terminated. *STAR ELECTRONICS GmbH & Co. KG* delivers the standard cable and an Active-Star for this connection method. See chapter 8.2 Accessory Parts.
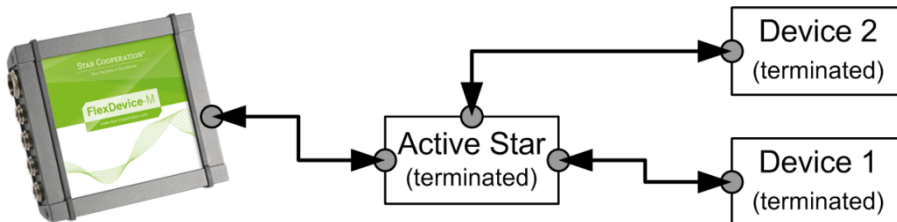

Figure 11: Example Point-to-Point connection with an Active-Star (figure shows a FlexDevice-M)

4.1.3 Daisy Chain Bus Interface Connections

When a point-to-point connection is not possible the best alternative is the daisy chain method to connect the FlexCard PXIe3/PCIe3 to an existing network. The daisy chain is the connection variant where all devices are connected in series, one after another. The first and the last device in the chain should terminate. *STAR ELECTRONICS GmbH & Co. KG* delivers a special daisy chain cable for this connection method. See chapter 8.2 Accessory Parts.
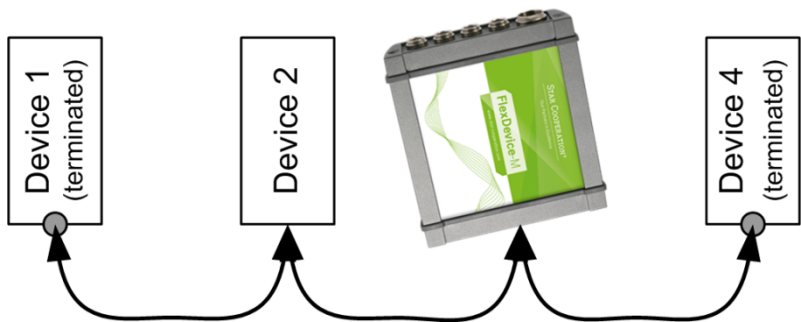
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Figure 12: Example daisy chain connection (figure shows a FlexDevice-M)

4.1.4 Stub Bus Interface Connections

The third method to connect the FlexCard PXIe3/PCIe3 to an existing network is the stub method. In this method, the devices are connected to a passive bus via stubs. Transmitted signals go from the transmitter via the stub to the bus and from the bus to the other devices. The devices that have the longest distance in between should be terminated. This connection variant produces the highest reflections in the network and should be avoided. *STAR ELECTRONICS GmbH & Co. KG* delivers a standard cable and a passive bus/star for this connection method. See chapter 8.2 Accessory Parts.
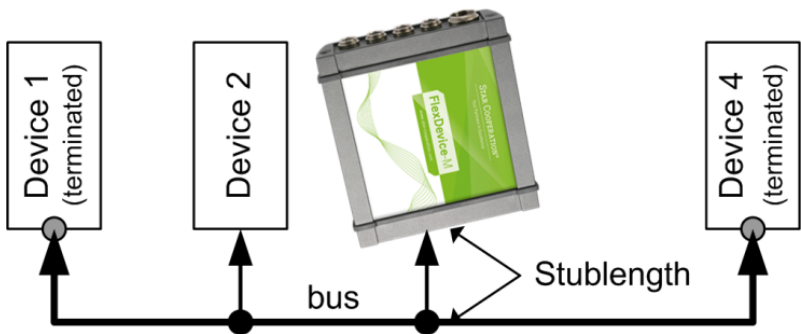

Figure 13: Example stub connection (figure shows a FlexDevice-M)

4.2 Configuration and Operation

4.2.1 Termination

The FlexCard PXIe3/PCIe3 supports bus termination controlled via software. For more information about termination refer to the manual of the used application (e.g. FlexConfig RBS).

4.3 Software Installation and Update

4.3.1 Preconditions

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

The minimum system requirements for installing and running the FlexCard PXIe3/PCIe3 hardware and software are:

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Microsoft Windows 10 64 bit with or without Secure Boot
- Computer/Processor: 2 GHz or faster AMD/Pentium-compatible processor
- 2 GB of RAM
- Display: VGA or higher-resolution monitor
- Peripheral keyboard and mouse or compatible pointing device
- FlexCard PXIe3: Free PXIe peripheral slot.
- FlexCard PCIe3: Free PCIe slot (1 PCIe lane or more).
- Microsoft Visual C++ 2010 Redistributable Package (x86)
- Microsoft Visual C++ 2010 Redistributable Package (x64)

4.3.2 Installation on Microsoft Windows Operating Systems

To install the FlexCard PXIe3/PCIe3 device driver and dynamic link library, please follow the steps below. The setup installs documentation in the form of pdf files to the local hard drive and creates shortcuts to them in the start menu.

Step 1

Insert the FlexCard PXIe3/PCIe3 hardware in the PXIe/PCIe–slot. Switch the power on and boot your computer. Windows will show this dialog.
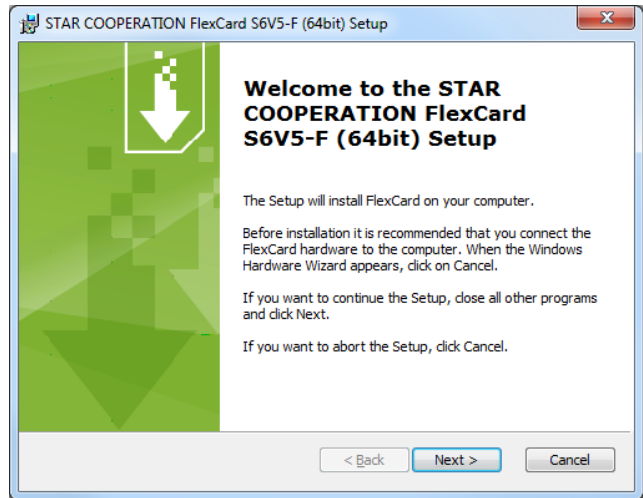
As the device driver will not be installed using the "Device Software Installation", click on the *[Close]* button to abort the wizard.
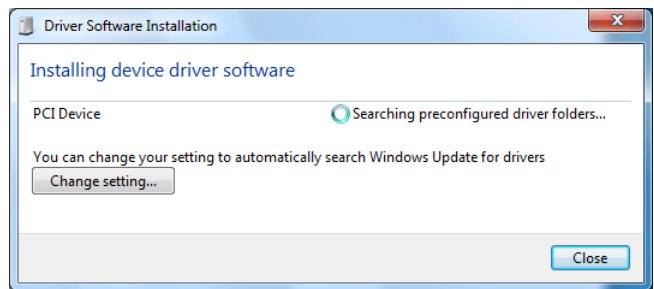
Step 2

To start the installation, double click the FlexCard setup. The installation wizard will start immediately and guide you through the installation.

Click on the *[Next]* button.

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Step 3

Read the license agreement and if you accept the agreement, activate the option *"I accept the terms..."* and click the *[Next]* button to continue the installation. Otherwise click *[Cancel]* to abort the installation.
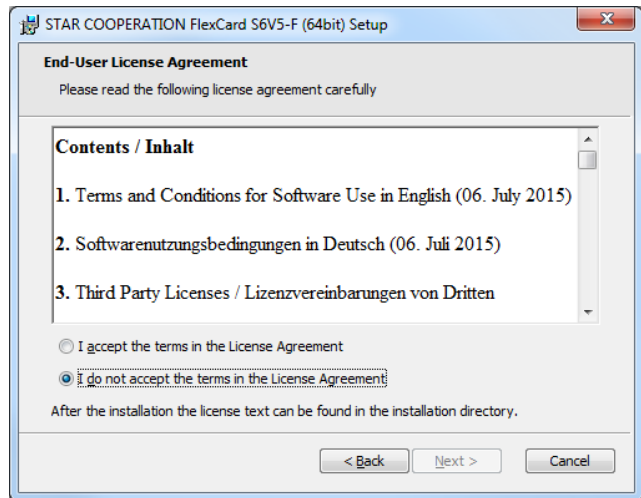
Step 4

Select the installation folder for the *FlexCard* files.

Note: The device drivers will be installed to the Windows system directory.
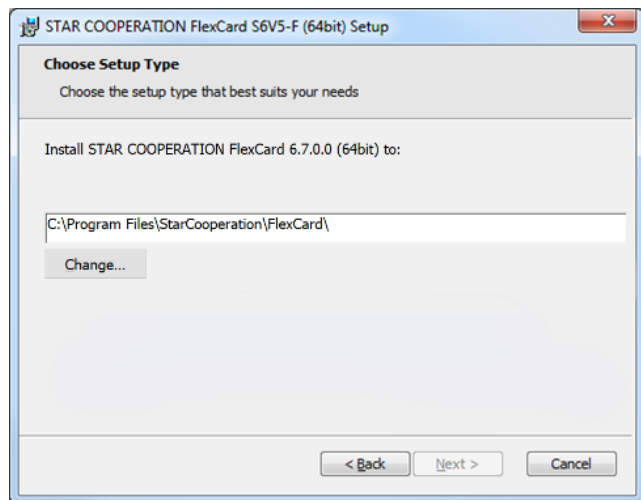
Step 5

The following warning dialog may appear, as the *FlexCard* device driver is not certificated by the Microsoft Hardware Quality Labs. Click on *[Install]* to proceed with the installation.
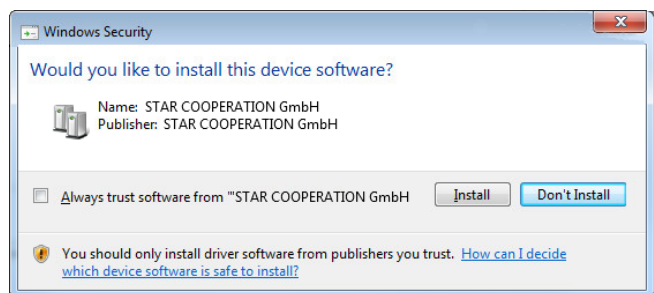
Step 6

A dialog box may appear. Click on *[OK]*.

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Step 7

Click *[Finish]* to complete the installation.

Step 8

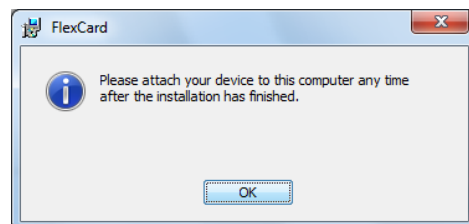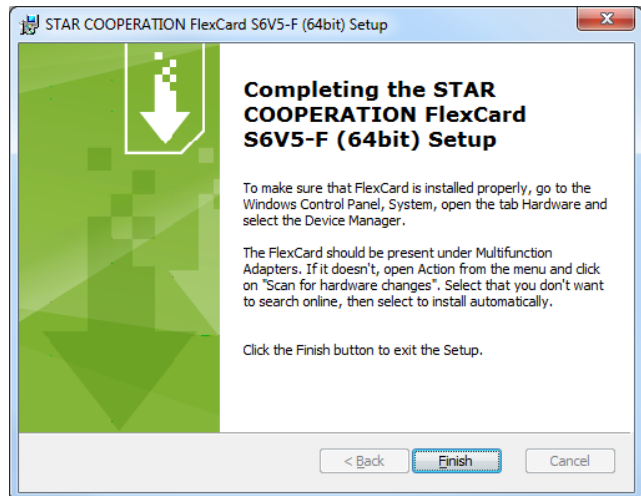After the installation of the device driver you will find the *FlexCard* entry in the *Device Manager* . The FlexCard PMC-II, FlexCard USB-M Control, FlexCard USB-M Data, FlexCard PXIe3, FlexCard PCIe3 drivers will appear in the folder *Multifunction adapters.* The FlexCard PMC-II Ethernet, FlexCard PXIe3/PCIe3 Ethernet drivers will appear in the folder *Network adapters*.
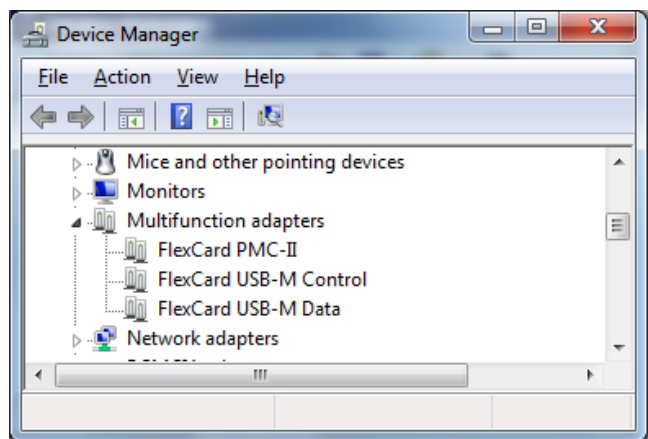
⚠	**NOTICE**
	It is highly recommended to install the *FlexCard* Windows driver via setup.msi and not via INF-file!

4.3.3 Uninstallation on Microsoft Windows Operating Systems
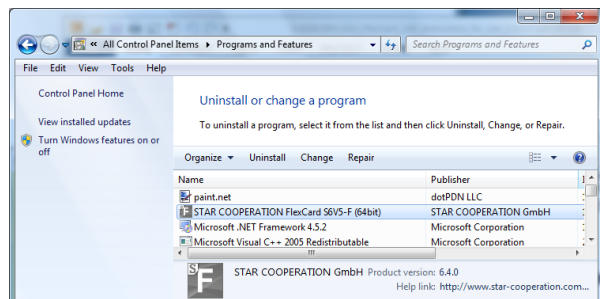
To uninstall FlexCard PXIe3/PCIe3 please follow these steps.

Uninstall the *FlexCard* driver via the Windows Control Panel:
***Start->Settings->Control Panel
->Add/Remove Programs***
Click *[Uninstall]* to uninstall the package.

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4.4   Available Operating Modes

There are three different operating modes for the FlexCard PXIe3/PCIe3:
- FlexCard mode
- FlexDevice mode
- Mixed mode

4.4.1 FlexCard Mode

Sending/receiving of bus data at the PCIe host system via the Windows driver. Use the fcBase API to control the device for the bus systems FlexRay and CAN. The API is described in document [5]. For the description of the usage of bus system Ethernet refer to document [6].

4.4.2 FlexDevice Mode

Execution of real time remaining bus simulations and gateways on the integrated ARM Cortex-A9 CPU. Use the application FlexConfig RBS to control the device. FlexConfig RBS is described in document [2].

4.4.3 Mixed Mode

Execution of real time remaining bus simulations on the integrated ARM Cortex-A9 CPU and receiving of all bus data at the PCIe host system (PC). Use the application FlexConfig RBS to control the real time remaining bus simulation. FlexConfig RBS is described in document [2]. Use the fcBase API to receive the bus data for the bus systems FlexRay, CAN and Ethernet. The API is described in document [6].

4.5   Change the Operating Mode

4.5.1 Change the Mode from FlexDevice/Mixed Mode to FlexCard Mode

To change the mode, it is **not** necessary to set the device to the factory mode.
Changing the mode requires two steps:

- Flash the fpga image.
- Flash the s19 file.

If the fpga distribution slot already has the correct fpga image type (FlexCard PXIe3: 0x1D0. FlexCard PCIe3: 0x1E0) the step "Flash the fpga image" can be skipped.
The step "Flash the s19 file " cannot be skipped.

4.5.1.1 Required files for changing the mode

The files required for the mode change can be found in the folder where you installed the FlexCard setup, in the subfolder *bin\images*. By default, the path is:

C:\Program Files\StarCooperation\FlexCard\bin\images

In this directory you find the tool FlexTFTP, the fpga images and the s19 files.

The directory can also be found via start menu. Open the start menu, go to "FlexCard" and open the shortcut "Images".
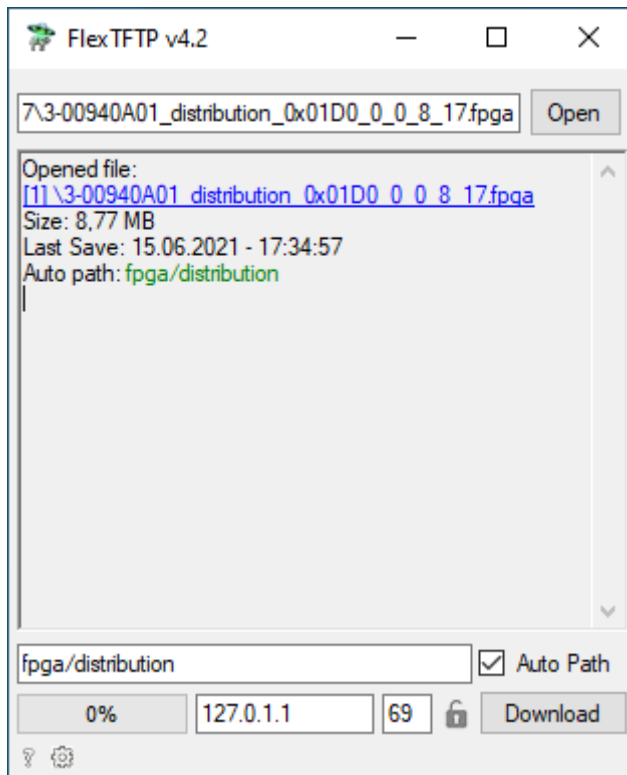
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Figure 14: Application FlexTFTP for flashing an fpga image or an s19 file

4.5.1.2 Flash the fpga image

1. Start the tool *FlexTFTP.exe*.

2. Activate the checkbox "*Auto Path*".

3. Required fpga file:

Hardware Type	File Name
FlexCard PXIe3	3-00940A01_distribution_0x01D0_x_x_x_x.fpga
FlexCard PCIe3	3-00950A01_distribution_0x01E0_x_x_x_x.fpga

4. Drag the *.fpga* file and drop it on FlexTFTP
   => The path in FlexTFTP switches to "*fpga/distribution*".

5. Enter the IPv4 address of the device (by default 127.0.1.1).

6. Set the IPv4 port to '69'.

7. Click on **[Download]**.
   => The progress bar goes from 0% to 100% and switches to 0% again, when the transfer to the RAM is completed.
   => However, after the data is written to the RAM, it needs to be transferred to the flash memory. This takes a while. During this process, the blue DIO[2] LED is continuously on. When this LED is off, the process is completed. Do not shut down the PC while the blue DIO[2] LED is on!

4.5.1.3 Flash the s19 file

Hardware type	File name
FlexCard PXIe3	FC_RBS_FlexCard-PXIe3_distribution.s19
FlexCard PCIe3	FC_RBS_FlexCard-PCIe3_distribution.s19

1. Start the tool *FlexTFTP.exe*.

2. Activate the button "Auto path".

1. Drag the *.s19* file and drop it on FlexTFTP.
=> The path in FlexTFTP switches to "*cpu/distribution*".

2. Enter the IPv4 address of the device (by default 127.0.1.1).

3. Set the IPv4 port to '69'.

4. Click on **[Download]**.
=> The progress bar goes from 0% to 100% and switches to 0% again, when the transfer to the RAM is completed.
=> However, after the data is written to the RAM, it needs to be transferred to the flash memory. This takes a while. During this process, the blue DIO[2] LED is continuously on. When this LED is off, the process is completed. Do not shut down the PC while the blue DIO[2] LED is on!

5. After these steps, the new cpu image is immediately loaded, but the fpga image is not loaded yet. The FlexConfig RBS running on the processor on the card is in the application state "error". This is an expected behavior here. To finalize the changes, you need to shut down the PC completely. It is not sufficient to just restart the PC/Windows!

6. After the PC was shut down and the started again, open the diagnosis page (see chapter 5.1). Go to "Hardware & Versions". Check that under Firmware, the Loaded Image Type is correct (FlexCard PXIe3: 0x1D0. FlexCard PCIe3: 0x1E0). The device is in the FlexCard Mode now.

4.5.2 Change the Mode from FlexCard Mode to FlexDevice/Mixed Mode

To change the mode, it is not necessary to set the device to the factory mode.

1. Open FlexConfig RBS.

2. In the Device Manager, connect your FlexCard PXIe3/PCIe3.

3. Right-click on the device. Select "Flash FPGA file...", choose the fpga file that is required by your FlexConfig RBS project and click on "Flash".

4. Wait until the flash process is completed.

5. Right-click on the device. Select "Flash S19 file...", choose the s19 file that was compiled by your FlexConfig RBS project and click on "Flash".

6. Wait until the flash process is completed.

7. After these steps, the new cpu image is immediately loaded, but the fpga image is not loaded yet. The FlexConfig RBS running on the processor on the card is in the application state "error". This is an expected behavior here. To finalize the changes, you need to shut down the PC completely. It is not sufficient to just restart the PC/Windows!

8. After the PC was shut down and the started again, open the diagnosis page (see chapter 5.1). Go to "Hardware & Versions". Check that under Firmware, the Loaded Image Type is correct (it should be the fpga image you flashed). The device is in the FlexDevice Mode now.

4.6 FPGA images

The FlexCard PXIe3/PCIe3 uses an FPGA image to access the automotive networks. The FPGA image defines what automotive network (FlexRay, CAN, …) is available at which connector. The operating mode decides how to get information about the used FPGA image.

4.6.1 FlexDevice and Mixed Mode

The FPGA image is selected in FlexConfig RBS.

4.6.2 FlexCard Mode

Following FPGA images are available:

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Device	FPGA image type
FlexCard PXIe3	0x1D0
FlexCard PCIe3	0x1E0

4.6.2.1 Image 0x1D0/0x1E0

The following table describes what hardware module is present at what Tiny slot.

Tiny slot 1	Tiny slot 2	Tiny slot 3	Tiny slot 4	Tiny slot 5
-	-	A: BusDecoder FlexRay A: E_RAY B: Busdecoder FlexRay B: E_RAY	A: ETH PCI Tri-MAC	A: BusDecoder CAN-FD A: M_CAN B: BusDecoder CAN-FD B: M_CAN

4.6.2.2 Image 0x1D0/0x1E0 FlexTiny support

The following table describes what FlexTiny 3 module can be mounted at what Tiny slot.

Tiny slot 1	Tiny slot 2	Tiny slot 3	Tiny slot 4	Tiny slot 5
-	-	FlexTiny 3 FR (3-0088-0A01)	FlexTiny 3 ETH_BR (3-0088-2C02)	FlexTiny 3 CAN_FD (3-0088-1E01)

It is possible to mount less FlexTiny modules than described in the table. In this case the other FlexTiny modules can be used normally.

4.7 Firmware Update

In order to update the firmware of a FlexCard PXIe3/PCIe3, check the document [4] Firmware Update. A firmware update via FlexUpdate is not supported.

4.8 License Update

To update the FlexCard PXIe3/PCIe3 with a new license file, refer to the document [3] FlexUpdate User Manual.

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5 Usage of the FlexCard PXIe3/PCIe3

The following describes the usage of the FlexCard PXIe3/PCIe3 in a PXI rack or a PC.

5.1 WebAdmin UI

After installation of the FlexCard PXIe3/PCIe3 setup, a FlexCard symbol appears in the task bar.
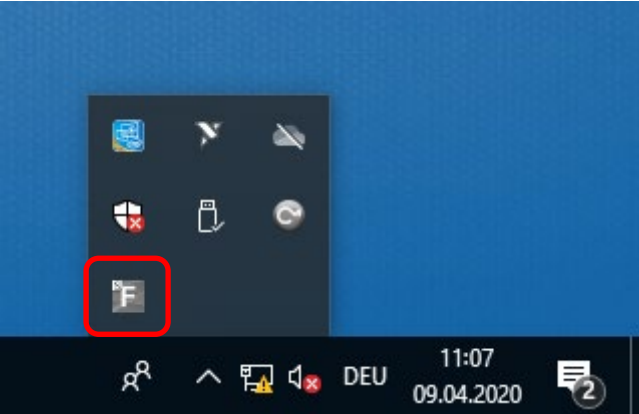

Figure 15: FlexCard task bar symbol

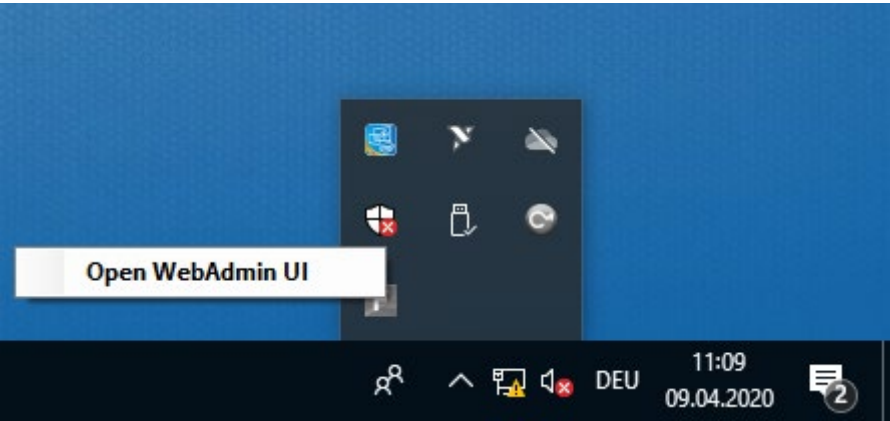Right-click on the symbol to display the menu.

Figure 16: FlexCard task bar symbol with menu

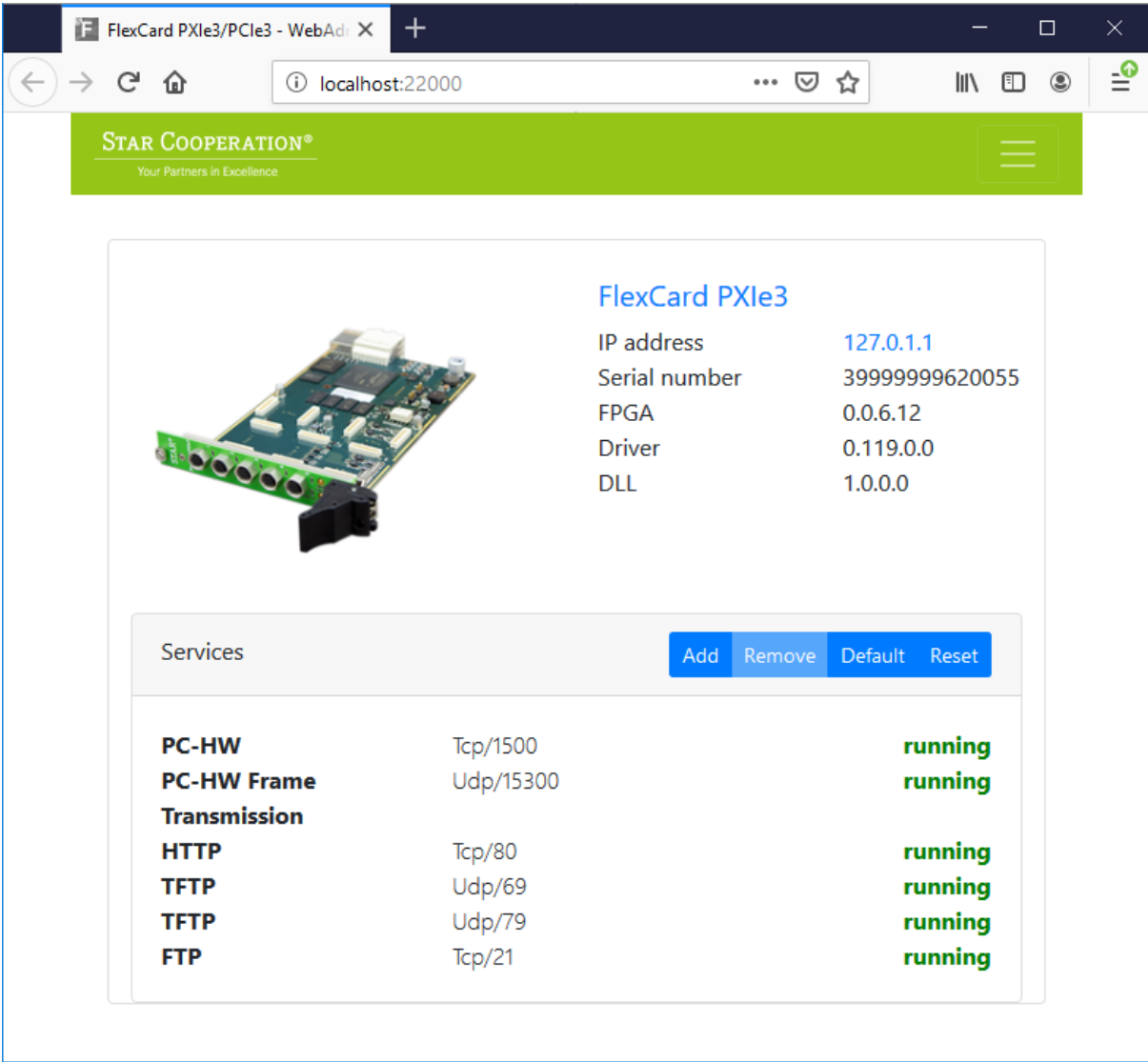Select "Open WebAdmin UI" to open the user interface in your web browser.

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Figure 17: FlexCard PXIe3 WebAdmin UI (FlexCard PCIe3 is similar)

The WebAdmin UI shows information about the connected FlexCard PXIe3/PCIe3 devices. The IP address of the device is listed. Use this IP address to access the device, e.g. in FlexConfig RBS or via PC-Hardware-Interface.

Click on the IP address to open the diagnosis page of the FlexCard PXIe3/PCIe3.

Under "Services", you can see the state of internal services. Usually it is not necessary to make any changes to the "Services".

If multiple devices are connected to the PC, they are listed next to each other in the WebAdmin UI.

5.2   Flash the FPGA

After flashing the FPGA, the change does not immediately take effect. You can continue to use the FlexCard PXIe3/PCIe3.

ⓘ	**NOTICE**
	The change of the FPGA image takes effect when the FlexCard PXIe3/PCIe3 is unpowered. To accomplish this, shut down the PC. A restart is not sufficient!

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6 Shipping, Maintenance and Disposal

Keep the package in which the FlexCard PXIe3/PCIe3 was shipped.

Store and transport the FlexCard PXIe3/PCIe3 in a cool, dry, dark environment. Don't store or transport it near sources of magnetic fields.

	NOTICE
	If you want to customize the components of the device, please contact *STAR ELECTRONICS GmbH & Co. KG*.

It is not necessary to clean the FlexCard PXIe3/PCIe3. Do not use rubber dissolving chemicals or equivalent cleaning materials.

FlexCard PXIe3/PCIe3 has no parts that require servicing.

	Dispose off properly per regulations of the country where end-of-life occurs.

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7 Troubleshooting

This chapter contains some frequently asked questions about the FlexCard PXIe3/PCIe3.

1	Effect	The application running on the device does not respond. An application update via PCIe local host is not possible.
	Solution	You can try to reset your device. See chapter 3.5.9 for more details.

2	Effect	I tried a reset, but the device is still not working.
	Solution	Please contact the STAR ELECTRONICS support team. When you contact the support team, please add the device information written on the labels to your request.

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8 Ordering Information

8.1 FlexCard PXIe3/PCIe3

Product	Description	Ordering number
FlexCard PXIe3	FlexCard PXIe3 hardware	3-V0940A01
FlexCard PCIe3	FlexCard PCIe3 hardware	3-V0950A01

8.2 Accessory Parts

Product	Description	Ordering number
FlexTiny III: FlexRay, CAN-FD/HS, Ethernet and more	Pluggable transceiver module with transceivers	Contact *STAR ELECTRONICS GmbH & Co. KG*
CAN/FlexRay bus cable (1 m)	2 * CAN/FlexRay (Binder to 1 * D-Sub)	3-00342J01
CAN/FlexRay bus cable (2 m)	2 * CAN/FlexRay (Binder to 1 * D-Sub)	3-00341J02
CAN/FlexRay Y-bus cable (2 m)	2 * CAN/FlexRay (Binder to 2 * D-Sub)	3-00341L02
100Mbit Eth bus cable (2 m)	1 * 100Mbit Eth (Binder to 1 * RJ-45)	3-00341O02
100Mbit Eth Y-bus cable (2 m)	2 * 100Mbit Eth (Binder to 2 * RJ-45)	3-00342M01
IEEE 802.3 100Base-T1 3 x bus cable (2 m)	3 * IEEE 100BaseT1 (Binder to 3 * D-Sub) This cable can also be used for BraodR-Reach.	3-00342O01
IEEE 802.3 100Base-T1 Y-bus cable (2 m)	2 * IEEE 100BaseT1 (Binder to 2 * D-Sub) This cable can also be used for BraodR-Reach.	3-00342Q01
FlexTiny fixation unit	Fixes the FlexTiny III against dropoff by vibrations	3-00940X01

8.3 Related Documents

Document	Description	Ordering number
[1] Instructions for Use FlexTiny3	Instructions for Use FlexTiny3	3-0088-0Z01-D01
[2] FlexConfig RBS User Manual	FlexConfig RBS User Manual	Contact *STAR ELECTRONICS GmbH & Co. KG*
[3] FlexUpdate User Manual	FlexUpdate User Manual	Contact *STAR ELECTRONICS GmbH & Co. KG*
[4] Firmware Update	Guide on how to update the firmware for FlexDevices and FlexCards	3-0016-1K01-D23
[5] FlexCard API Documentation	FlexCard API Documentation	3-0009-0S01-D03
[6] FlexCard PMC2 PXIe3 PCIe3 Ethernet UserManual	FlexCard PMC2 PXIe3 PCIe3 Ethernet UserManual	3-0094-0A01-D16

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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 MΩ/cm^2), grounded through a ground cable (conductive cable from protected equipment to ground isolated through a 1 MΩ 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 MΩ and 1.5 MΩ) 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
BP	Bus plus
BM	Bus minus
CAN	Controller Area Network
EMC	Electromagnetic Compatibility
ESD	Electro-Static Discharge
FR	FlexRay
ETH	Ethernet
BRR	BroadR-Reach
NC	Not Connected

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9.2.2 List of Tables

9.2.3 List of Figures

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