

Installation- and Operating instructions for

FC9001-0010, FC9011, FC9002, FC9004 FC9022, FC9062

PCI/PCIe Cards for Ethernet

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1 Foreword

1.1 Notes on the Documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

1.1.1 Liability Conditions

The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. In the event that it contains technical or editorial errors, we retain the right to make alterations at any time and without warning. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.2 Trademarks

Beckhoff[®], TwinCAT[®], EtherCAT[®], Safety over EtherCAT[®], TwinSAFE[®] and XFC[®] are registered trademarks of and licensed by Beckhoff Automation GmbH.

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1.1.3 Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with corresponding applications or registrations in various other countries.

The TwinCAT Technology is covered, including but not limited to the following patent applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

1.1.4 Copyright

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1.1.5 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH apply.

1.2 Safety instructions

1.2.1 State at Delivery

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the product is only used as intended (see chapter *Product Description*)
- the product is in a sound condition and in working order during operation
- the product is operated, maintained and repaired only by suitably qualified and authorized personnel
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating manual and in particular the safety notes contained herein
- the operation manual is in good condition and complete, and always available for reference at the location of the product
- none of the safety and warning notes attached to product are removed, and that all notes remain legible.

1.3 Description of safety symbols

The following safety symbols are used in this operating manual. They are intended to alert the reader to the associated safety instructions.

	Acute risk of injury!
DANGER	If you do not adhere the safety advise adjoining this symbol, there is immediate danger to life and health of individuals!
<u>ـ</u>	



Risk of injury!

If you **do not** adhere the safety advise adjoining this symbol, there is danger to life and health of individuals!

CAUTION individuals!	Hazard to individuals! If you do not adhere the safety advise adjoining this symbol, there is obvious hazard to individuals!

Hazard to devices and environment

Attention If you do not adhere the notice adjoining this symbol, there is obvious hazard to materials and environment.

	Note or pointer
Note	This symbol indicates information that contributes to better understanding.

2 Product Description

2.1 Product Overview

2.1.1 FC9001-0010, FC9011, FC9022 PCI Ethernet



The Ethernet PCI network cards FC9001-0010, FC9011 und FC9022 from Beckhoff save space and costs. They can be used in office and automation networks and offer the following benefits:

- plug-and-play interface
- 10/100/1,000 Mbit/s (FC9011, FC9022), 10/100 Mbit/s (FC9001-0010), full duplex
- automatic baud rate setting according to IEEE 802.3u
- maximum performance through hardware-integrated checksum creation and verification
- The hardware side supports Quality of Service (QoS) through prioritised multiple queues.
- Wake on LAN
- Boot from LAN (PXE) (only FC9011)

Naturally, the cards (or individual channels) can also be operated with TwinCAT drivers – and therefore in real-time.

2.1.2 FC9002, FC9004 PCI Ethernet



Up to four Ethernet channels in one slot: The Ethernet PCI network cards from Beckhoff save space and costs. They can be used in office and automation networks and offer the following benefits:

- plug-and-play interface
- 10/100 Mbit/s, full duplex
- automatic baud rate setting according to IEEE 802.3u for each channel
- maximum performance through hardware-integrated checksum creation and verification
- The hardware side supports Quality of Service (QoS) through prioritised multiple queues.

Naturally, the cards (or individual channels) can also be operated with TwinCAT drivers – and therefore in real-time.

2.1.3 FC9062 PCIe Modul



Beckhoff PCIe modules are based on a new definition of highly integrated PCI Express plug-in cards and follow the trend towards ever smaller PCs. The function of PC plug-in cards is integrated in a compact format that is suitable for harsh industrial environments.

The 3¹/₂-inch motherboard CB3052 offers four PCI Express lanes to be distributed to the PCIe module slots or standard plug-in card slots. The result are PCs with module slots and/or slots for plug-in cards. A PCIe module is connected to the motherboard via one PCI Express lane with a data transfer rate of 2 Gigabit. A module can therefore provide two Gigabit Ethernet interfaces, for example.

The FC9062 module complements the slide-in IPC C5210, the Panel PC CP62xx and the control cabinet IPCs C6515, C6525 and C6930 with two Gigabit Ethernet ports. If two modules are used, these PCs have a total of six Ethernet interfaces, while the PCI Express socket continues to be available for a seventh Ethernet port or a fieldbus interface for PROFIBUS, CANopen, DeviceNet or SERCOS. If only one of the two module slots is equipped with a PCIe module, the second slot is available for feeding motherboard interfaces such as COM ports, USB or sound out of the PC. The connection for a Mini PCI card can also be fed out through the module slots, even if the basic configuration of the PC, e.g. the C6515, does not allow for Mini PCI fieldbus cards.

2.2 Technical data

2.2.1 FC9001-0010, FC9011, FC9002, FC9004

Technical data	FC9001-0010	FC9011	FC9002	FC9004		
Bus system	Ethernet (all Ethernet (IEEE 802.3) based protocols)					
Number of Ethernet channels	1	1	2	4		
Ethernet Interface	10BASE-T/ 10BASE-T/ 100BASE-TX 100BASE-TX/ 1000BASE-TX 1000BASE-TX/		10BASE-T/ 100BASE-TX			
Ethernet sockets	1 x RJ45		2 x RJ45	4 x RJ45		
Cable length	maximum 100 m up	to Hub, Switch or end	l device			
Baud rate	10/100 MBit/s IEEE 802.3u auto-negotiation, full duplex at 10 or 100 MBit/s	10/100/1000 MBit/s IEEE 802.3ab auto-negotiation, full duplex at 10/100/1000 MBit/s	10/100 MBit/s IEEE 802.3u auto-negotiation, full duplex at 10 or 100 MBit/s, separate settings for each channel			
Diagnose	2 LEDs per channel: - Link/ Speed (Greer - Activity	2 LEDs per channel: - Link/ Speed (Green = 100MBit/ Orange = 1GBit) - Activity				
Interface to the PC	32 Bit Plug-and-Play PCI-Interface					
Standard driver	standard operating system drivers for Intel-compatible NIC		Standard driver for Intel 8255xER series or Beckhoff driver for Windows 2000/XP (Drivers can be selected separately for each channel)			
Real time driver	TwinCAT driver for r	eal time Ethernet	•			
Supply voltage (PCI-Bus)	5 V					
Current consumption typ. (PCI- Bus, 5 V)	200 mA	350 mA	800 mA	1200 mA		
Weight	45 g	45 g	75 g	95 g		
Dimensions (B x H x T, without slot plate)	18 x 45 x 120		18 x 95 x 125			
Permissible ambient temperature range during operation	0°C + 55°C					
Permissible ambient temperature range during storage	-25°C + 85°C					
Permissible relative humidity	95%, no condensation					
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29					
EMC resistance burst / ESD	according to EN 61000-6-2 / EN 61000-6-4					
Installation position	variable					
Approval	CE					

2.2.2 FC9022, FC9062

Technical data	FC9022	FC9062		
Bus system	Ethernet (all Ethernet (IEEE 802.3) based protocols)			
Number of Ethernet channels	2			
Ethernet Interface	10BASE-T / 100BASE-TX/ 1000BASE-TX			
Ethernet sockets	2 x RJ45			
Cable length	maximum 100 m up to Hub, Switch or end	l device		
Baud rate	10/100 MBit/s, IEEE 802.3ab auto-negotiation, full duplex at 10, 100 or 1000 MBit/s, separate settings for each channel			
Diagnose	2 LEDs per channel: - Link/ Speed (Green = 100MBit/ Orange = - Activity	= 1GBit)		
Interface to the PC	1x PCIe-Interface Plug-And-Play			
Standard driver	Standard driver for Intel 82574L series or Beckhoff driver for Windows 2000/XP/Win7 (Drivers can be selected separately for each channel)			
Real time driver	TwinCAT driver for real time Ethernet			
Supply voltage	3,3 V			
Current consumption	800 mA typical			
weight	55 g	45 g		
Dimensions (B x H x T, without slot plate)	18 x 62 x 100	18 x 46 x 91		
Permissible ambient temperature range during operation	0°C + 55°C			
Permissible ambient temperature range during storage	-25°C + 85°C			
Permissible relative humidity	95%, no condensation			
Vibration / shock resistance	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29			
EMC resistance burst / ESD	according to EN 61000-6-2 / EN 61000-6-4			
Installation position	variable			
Approval	CE			

2.3 Ethernet

Ethernet was originally developed by DEC, Intel and XEROX (as the "DIX" standard) for passing data between office devices. The term nowadays generally refers to the *IEEE 802.3 CSMA/CD* specification, published in 1985. Because of the high acceptance around the world this technology is available everywhere and is very economical. This means that it is easy to make connections to existing networks.

There are now a number of quite different transmission media: coaxial cable (10Base5), optical fiber (10BaseF) or twisted pairs (10BaseT) with screen (STP) or without screen (UTP). A variety of topologies such as ring, line or star can be constructed with Ethernet.

Ethernet transmits Ethernet packets from a sender to one or more receivers. This transmission takes place without acknowledgement, and without the repetition of lost packets. To achieve reliable data communication, there are protocols, such as TCP/IP, that can run on top of Ethernet.

2.3.1 Basic Principles

2.3.1.1 The Internet Protocol (IP)

The internet protocol (IP) forms the basis of this data communication. IP transports data packets from one device to another; the devices can be in the same network, or in different networks. IP here looks after the address management (finding and assigning MAC-IDs), segmentation and routing. Like the Ethernet protocol, IP does not guarantee that the data is transported - data packets can be lost, or their sequence can be changed.

TCP/IP was developed to provide standardized, reliable data exchange between any number of different networks. TCP/IP is thus substantially independent of the hardware or software being used. Although the term is often used as if it were a single concept, a number of protocols are layered together: e.g. IP, TCP, UDP, ARP and ICMP.

2.3.1.2 Transmission Control Protocol (TCP)

The Transmission Control Protocol (TCP) which runs on top of IP is a connection-oriented transport protocol. It includes error detection and error handling mechanisms. Lost telegrams are repeated.

2.3.1.3 User Datagram Protocol (UDP)

UDP is connectionless transport protocol. It provides no control mechanism when exchanging data between sender and receiver. This results in a higher processing speed than, for example, TCP. Checking whether or not the telegram has arrived must be carried out by the higher-level protocol.

2.3.1.4 Internet Control Message Protocol (ICMP)

It is used by end devices, to exchange information about the current status of the internet protocol.

2.3.1.5 Address Resolution Protocol (ARP)

Performs conversion between the IP addresses and MAC addresses.

2.3.1.6 BootP

The BootP protocol allows the TCP/IP address to be set or altered, by addressing the network device with its MAC-ID.

3 Installation

3.1 Installation in the PC



Follow the usual ESD guidelines

The Ethernet cards are supplied in ESD packaging. Follow the usual ESD guidelines for handling PC cards during installation!

- 1. Before installing the Ethernet card, switch off the PC and any external power supplies, and separate the PC from the mains.
- 2. Open the PC case.
- 3. For a free PCI slot on the motherboard, remove the metal plate in the PC case.
- 4. Insert the Ethernet card into the free PCI slot and fix it with the screw or device provided. Ensure that there is sufficient space between the Ethernet card and other PC components, so that the Ethernet card cannot come into contact with other plug-in cards or memory components etc.
- 5. Close the PC case.
- 6. Connect the Ethernet cables with the optical fibre connections of the Ethernet card.
- 7. Connect the PC to the mains and switch it on.
- 8. The Ethernet card will be detected as new hardware when the operating system starts up. Follow the assistant's instructions for installing the Ethernet card driver.
- 9. If you wish to use the TwinCAT driver for real-time Ethernet and EtherCAT, you should now install TwinCAT
 - install or modify the driver.

The Ethernet card does not require an external power supply. It is supplied directly from the PC via the PCI bus. The power supply of the PC has to be adequate for meeting the power requirement of the Ethernet cards, particularly if several Ethernet cards are installed.

3.2 TwinCAT driver for Ethernet cards



First install Software

Install the Beckhoff TwinCAT automation software before installing the Beckhoff Ethernet card.

3.2.1 Driver Overview

TwinCAT delivers two different drivers for Ethernet cards:

- TwinCAT driver for real-time Ethernet
- TwinCAT RT-Ethernet Intermediate Driver.

TwinCAT driver for real-time Ethernet

The TwinCAT driver for real-time Ethernet works only for Ethernet cards with Intel chipset!

It supports hard real time for Beckhoff Real Time Ethernet and EtherCAT applications.

TwinCAT RT-Ethernet Intermediate Driver

The TwinCAT RT-Ethernet Intermediate Driver works also with other network cards that have no Intel chip set,

It is an evaluation driver for laboratory and test operation, to be able to test TwinCAT also with other network cards that have no Intel chip set. It supports no hard real time and may cause jitter!

Further information about TwinCAT RT-Ethernet Intermediate Driver may be found in the TwinCAT Information System.

3.2.2 Installation of the TwinCAT driver for real-time Ethernet

There are three ways to install the TwinCAT driver for real-time Ethernet on your PC.

- Driver installation using the Add New Hardware Wizard: This is the usual way to install hardware drivers.
- Driver substitution via the TwinCAT System Manager: If your operating system installed its own driver for the Beckhoff Intel PCI/Ethernet card, you can substitute this driver by the TwinCAT driver for real-time Ethernet manually in order to be able to take advantage of its real-time capability.
- Manual driver installation: If your operating system installed its own driver for the Beckhoff Intel PCI/Ethernet card, you can substitute the TwinCAT driver for real-time Ethernet manually in order to be able to take advantage of its real-time capability.

3.3 Driver installation using the Add New Hardware Wizard

	First install Software
Note	Install the Beckhoff TwinCAT automation software before installing the Beckhoff Ethernet card.
	Installation under Windows 2000 and Windows XP

i	Instanation under windows 2000 and windows AP
Note	All screen shots of this documentation are made under Windows 2000. Under Windows XP, the TwinCAT driver is installed in the same way.

After installation of the Beckhoff Ethernet card, Windows 2000, for example, comes up with the following message during start-up:

New ha	w hardware detected					
	Eth	ernet Controller				
	New ha	ardware detect	ed			
		PCI-PCI bric	lge			
		New hardware	e detected			
		Eth	ernet control	ler		
			New hardv	vare detected		
		Please wait	H	TwinCAT-Intel PCI E	Ethernet adapter	
			Installatior	l		

Follow the instructions of the Add Hardware Wizard.



Allow the assistant to search for a suitable driver.

Hardware Update Wizard				
Instal hardware driver A device driver is a programm, that enables the operating system to access the device.	2			
This wizard will finish the instalation of the device:				
TwinCAT-Intel PCI Ethernet Adapter				
Device drivers are programms to control the hardware. New driver files are necessarv for the new device. Click next to search for these driver files and finnish the installation.				
How do you want to continue?				
Search for a suitable driver for the device (recommended)				
Eist all drivers known for the device and choose one by your own.				
< Back Next > Cancel				

The TwinCAT driver for real-time Ethernet is included with the Beckhoff TwinCAT automation software.

Hardware Update Wizard				
Search for driver files Specify, where the driver files should be searched for.				
Search for driver files for the following device:				
TwinCAT-Intel PCI Ethernet Adapter				
The wizard searches for the best driver at the driver database and at the spcified drives.				
Click Next to start the search. If searching should be done on a floppy disk or a CD ROM drive, insert the disk previously.				
Other sources:				
🗖 Floppy drive				
🗖 CD ROM drive				
Specify other source				
Microsoft Windows Update				
< Back Next > Cancel				

If you have installed the Beckhoff TwinCAT automation software before installing the Beckhoff Ethernet card, the Add New Hardware Wizard will find the TwinCAT driver for real-time Ethernet in the driver database on the hard disk of your PC.

Hardware Update Wizard		
Driver files - search results The search for the driver files for the device has been finished.		
A driver was found for the following device:		
TwinCAT-Intel PCI Ethernet Adapter		
A driver was found for the device. Click Next to install this driver.		
c:\winnt\inf\tci8255x.inf		
< Back Next > Cancel		

Operation of the TwinCAT drivers for real-time Ethernet requires no digital signature from Microsoft. Beckhoff has thoroughly tested this driver in conjunction with the supported hardware and has verified compatibility with Windows 2000 and XP.

Click Yes to continue with the rest of the installation.



The TwinCAT driver for real-time Ethernet was installed successfully for an Ethernet port. Exit the installation with *Finish*.



If you are using a multi-channel Beckhoff Ethernet card, repeat the driver installation procedure for each additional channel:



Now you have to activate the TwinCAT Ethernet Protocol (see chapter *Activating the TwinCAT Ethernet protocol*).

3.3.1 Resources

Example for the resources of an FC900x under Windows 2000 (Control Panel/System/Hardware/Device Manager/Network adapters/TwinCAT Intel PCI-Ethernet adapter/Resources):

TwinCAT Intel PCI Ethernet Adapter F	Properties ? 🗙		
General Extended Settings Driver	Resources		
TwinCAT-Intel PCI Ethernet A	Adapter		
<u>B</u> esources Settings:			
Resource Type	Setting		
Memory Range	FAFFF000 - FAFFFFF		
I/O Range	ECC0-ECFF		
Memory Range	FAFC0000 - FAFDFFFF		
Interrupt Request (IRQ)	09		
Setting based on: Present Configuration	ion		
Use automatic settings	Change Setting		
Conflicting device list:			
No conflicts.			
	OK Cancel		

3.4 Driver substitution using the TwinCAT System Manager



Install the Beckhoff TwinCAT automation software before installing the Beckhoff Ethernet card.



Installation under Windows 2000 and Windows XP

First install Software

All screen shots of this documentation are made under Windows 2000. Under Windows XP, the TwinCAT driver is installed in the same way.

Click t al the right bottom side of the Windows taskbar on the TwinCAT icon and start the TwinCAT System-Manger.



Click on Show Real Time Ethernet Compatible Devices in the Options menu.



Now the TwinCAT System Manager shows the real time capable (Compatible devices) and non real time capable (Incompatible devices) network cards.

Chose a real time capable network card and click on the Install button.

Installation of TwinCAT RT-Ethernet Adapters

Installation of TwinCAT RT-Ethernet Adapters	×
Ethernet Adapters Installed and ready to use devices Compatible devices LAN-Connection 2 - Intel(R) 10/100 Ethernet Controller Incompatible devices LAN-Connection 1 - 3Com 3C920 Integrated Fast Ethernet Controller Disabled devices	Update List Install Bind Unbind

Now the TwinCAT System Manager installs the TwinCAT driver for real-time Ethernet and the TwinCAT Ethernet Protocol for the chosen device.

Digital Signature not found	×
	The Microsoft digital signature affirms that software has been tested with Windows and that the software has not been altered since it was tested. The software that you are about to install does not contain a Microsoft digital signature. Therefore, there is no guarantee that this software works correctly with Windows.
	TwinCAT-Intel PCI Ethernet Adapter
	If you want to search for Microsoft digitally signed software, visit the Windows Update Web site at http://windowsupdate.microsoft.com to see if one is available.
	Do you want to continue the installation?
	Yes No More Info

Operation of the TwinCAT drivers for real-time Ethernet requires no digital signature from Microsoft. Beckhoff has thoroughly tested this driver in conjunction with the supported hardware and has verified compatibility with Windows 2000 and XP.

Click Yes to continue with the rest of the installation.

Installation of TwinCAT RT-Ethernet Adapters	×
Installation of TwinCAT RT-Ethernet Adapters Ethernet Adapters Installed and ready to use devices Installed and ready to use devices Incompatible devices Incompatible device	Vipdate List
Uisabled devices	Show Bindings

The TwinCAT driver for real-time Ethernet and the belonging TwinCAT Ethernet Protocol were installed.

stallation of TwinCAT RT-Ethernet Adapters	
Ethernet Adapters Installed and ready to use devices LAN-Connection 2 - TwinCAT-Intel PCI Ethernet Adapter Wire TwinCAT Ethernet Protocol Compatible devices LAN-Connection 1 - 3Com 3C920 Integrated Fast Ethernet Controller Disabled devices	Update List Install Bind Unbind

Activate the Show Bindings Check-Box to display the bounded protocol.

3.5 Manual driver installation

If your operating system installed its own driver for the Beckhoff Intel PCI/Ethernet card, you have to install the TwinCAT driver for real-time Ethernet manually in order to be able to take advantage of its real-time capability.

i Note	First install Software Install the Beckhoff TwinCAT automation software before installing the Beckhoff Ethernet card
	Installation under Windows 2000 and Windows XP

i	Installation under windows 2000 and windows AP
	All screen shots of this documentation are made under Windows 2000.
Note	Under Windows XP, the TwinCAT driver is installed in the same way.

Click on Network and Dial-up Connections under Start/Settings/Control Panel.

Click on an unused LAN connection (LAN connection 2).

🔁 Network connections	×
File Edit View Favorites Tools Advanced Help	
] 🗢 Back 🛛 🔻 🔻 🔁 🔍 Search 🖓 Folders 🎯 History 🛛 😤 💥 🖄 💷 🔻	
Address 🖻 Network Connections	•
Create new LAN Connection 1 LAN Connection 2 LAN Connection 3 LAN Connection Connection	4
Intel (R) PRO/100 S Desktop Adapter #2	_//

The properties of LAN connection 2 are displayed.

Properties of LAN connection 2
General Authentication
Connect using:
Intel (R) PRO/100 S Desktop Adapter #2
C <u>o</u> nfigure
This connection uses the following items:
🗹 🔜 Client for Microsoft Networks
🛛 🖉 📇 File and Printer Sharing for Microsoft Networks
🗹 🧊 Network monitor driver
☑ 🐨 Internet protocol (TCP/IP)
Install Uninstall Properties
Description
TCP/IP, the standard protocol for WAN networks, that enables data exchange over different networks connected to each other.
Show icon in notification area when connected
OK Cancel

Click on Configure.

Intel(R) PR	O/100 S Desktop A	dapter #2 Prop	erties	? ×
General	Extended Settings D	river Resources		
	TwinCAT-Intel PCI E	thernet Adapter		
	Manufacturer:	Beckhoff		
	Date:	Nicht verfügbar		
	Version:	2.9.0.1		
	Digital signature:	Not digital signe	d	
Click Driver Details to get information about the driver files loaded for the device. You can click Uninstall to uninstall the driver files for this device. If you want to update the driver files for the device, click Update Driver.				
Dr	iver Details	Uninstall	Upda	te Driver
			ОК	Cancel

Change to the *Driver* tab, click on *Update Driver* and follow the instructions of the Add New Hardware Wizard.

Hardware Update Wizard		
	Welcome	
	This wizard updates a device driver.	
	Click Next to continue.	
	< Back Next > Cancel	

If you wish to select the associated driver yourself, select the option to display a list of all known drivers.

Hardware Update Wizard			
Instal hardware driver A device driver is a programm, that enables the operating system to access the device.			
The wizard updates the driver for the following device:			
TwinCAT-Intel PCI Ethernet Adapter			
By updating the driver the functionality of the device is extended or its performance is improved.			
How do you want to continue?			
Search for a suitable driver for the device (recommended)			
• List all drivers known for the device and choose one by your own.			
< Back Next > Cancel			

If the Beckhoff TwinCAT automation software is already installed, the Add New Hardware Wizard will offer the TwinCAT driver for real-time Ethernet.

Select the TwinCAT driver for real-time Ethernet.

Hardware Update Wizard		
Select network adapter Witch network adapter do you want to install?		
Click the network adapter that matches your hardware, then click OK. If you have an installation disk, click Have Disk.		
Network adapter:		
TwinCAT-Intel PCI Ethernet Adapter Intel 10/100 PCI-Adapter		
Compatible hardware components Have Disk		
All hardware components of this device class		
< Back Next > Cancel		

Start installing the selected driver.

Hardware Update Wizard			
Start device driver installation The device driver will be installed with standard settings.			
The driver for the following device is ready to be installed:			
TwinCAT-Intel PCI Ethernet Adapter			
The hardware can be installed with standard settings. Click Next to install the software for the new hardware.			
< Back Next > Cancel			

Operation of the TwinCAT drivers for real-time Ethernet requires no digital signature from Microsoft. Beckhoff has thoroughly tested this driver in conjunction with the supported hardware and has verified compatibility with Windows 2000 and XP.

Click Yes to continue with the rest of the installation.



The TwinCAT driver for real-time Ethernet was installed successfully. Exit the installation with Finish.

Hardware Update Wizard			
	Completing the Wizard		
	TwinCAT-Intel PCI Ethernet Adapter		
	The software for the device has been installed.		
	Click Finnish to close the wizard.		
	< Back Finnish>		

Now you have to activate the TwinCAT Ethernet Protocol (see chapter *Activating the TwinCAT Ethernet protocol*).

3.5.1 Resources

Example for the resources of an FC900x under Windows 2000. (Control Panel/System/Hardware/Device Manager/Network adapters/TwinCAT Intel PCI-Ethernet adapter/Resources):

TwinCAT Intel PCI Ethernet Adapter Properties			
General Extended Settings Driver Resources			
TwinCAT-Intel PCI Ethernet Adapter			
<u>R</u> esources Settings:			
Resource Type Setting			
Memory Range FAFFF000 - FAFFFFF			
I/O Range ECC0 - ECFF			
Memory Range	Memory Range FAFC0000 - FAFDFFFF		
Interrupt Request (IRQ) 09			
Setting based on: Present Configuration			
🔽 Use automatic settings		Chan	ge Setting
Conflicting device list:			
No conflicts.			
		ОК	Cancel

3.6 Activating the TwinCAT Ethernet protocol

In order to be able to make use of real-time capability, the TwinCAT Ethernet protocol has to be activated for the Beckhoff Intel PCI-Ethernet card.

Under *Start/Settings/Control Panel/Network and Dial-up Connections* click on the LAN connection for which you would like to activate the TwinCAT Ethernet protocol (in the example LAN connection 2).

Properties of LAN connection 2		
General Authentication		
Connect using:		
TwinCAT-Intel PCI Ethernet Adapter		
C <u>o</u> nfigure		
This connection uses the following items:		
 ☑ Internet protocol (TCP/IP) 		
Install		
Description TCP/IP, the standard protocol for WAN networks, that enables data exchange over different networks connected to each other.		
Show icon in notification area when connected		
OK Cancel		

Click on Install.

Choose type of network component	? ×
Click on the network component that has to be installed:	
E Client Service Protocol	
Description Via a protocol a computer comunicates to another computer.	
Add Cancel	

Select Protocol (not Service!) and click on Add.

Choose network protocol 🛛 🔀		
Click the N an installat	etwork Protocol that you want to install, then click OK. If you have ion disk for this component, click Have Disk.	
Manufacturer:	Network Protocol:	
Beckhoff Microsoft	TwinCAT Ethernet Protocol TwinCAT Ethernet Protocol for all Network Adapters	
	Have Disk	
	OK Cancel	

Under Beckhoff select the option TwinCAT Ethernet Protocol and click OK.

	Beckhoff TwinCAT Ethernet protocol is not available		
Note	If the Beckhoff TwinCAT Ethernet protocol is not available for selection despite the far that TwinCAT and the TwinCAT driver for real-time Ethernet have been installed, clic on <i>Data carrier</i> , then <i>Search</i> , and select the file <i>TcEther.inf</i> in folder <u>C:\Windows\inf</u> .		
	If the folder <u>C:\Windows\inf</u> is not displayed, activate the following options in Windows Explorer under <i>Tools/Folder Options/View</i> :		
	Show content of system folders		
	Hidden files and folders - Show all files and folders		

	Controlling real applications with TwinCAT Ethernet Protocol
Attention	For controlling real applications choose necessarily the <i>TwinCAT Ethernet Protocol</i> , not the TwinCAT Ethernet Protocol for all Network Adapters!
	The <i>TwinCAT Ethernet Protocol for all Network Adapters</i> just an evaluation protocol to test TwinCAT also with other network adapters that have no Intel chip set. It supports no hard real time and may cause jitter!

The TwinCAT Ethernet protocol should now be displayed in the list of components.

Properties of LAN connection 2	? ×
General Authentication	
Connect using:	
TwinCAT-Intel PCI Ethernet Adapter	
	C <u>o</u> nfigure
This connection uses the following items:	
🗹 🚍 Client for Microsoft Networks	
🔽 🚚 File and Printer Sharing for Microsoft Networks	
TwinCAT Ethernet Protocol	
Network monitor driver	
Contract protocol (TCP/P)	
I <u>n</u> stall <u>U</u> ninstall F	Properties
A driver to support real time VO on NDIS devices	
Show icon in notification area when connected	
Schließen	Abbrechen

The TwinCAT Ethernet Protocol can be started by issuing can the command *net start TcEther* in a DOS Command Prompt or by restarting the PC. The TwinCAT Ethernet Protocol will be started whenever the PC is restarted.



3.7 Searching for devices

Switch TwinCAT to configuration mode.

💡 About TwinCAT		
 E Log View System Manager PLC Control 		
이 ^은 <u>R</u> ealtime Settings Rou <u>t</u> er	×	
<u>S</u> ystem	×	🚱 Start
ĪO	۲	💁 Stop
PLC	×	💁 <u>R</u> estart
Properties		🙆 Config

Start the TwinCAT System Manager. Using the right mouse button, start searching for new devices under the branch *I/O Configuration \I/O devices* or via the magic wand button in the button bar.



The system manager will search for I/O devices (e.g. fieldbus cards) installed on the PC. In the example shown, the FC9004 channels for which

- 1. the TwinCAT driver for real-time Ethernet is installed and
- 2. the TwinCAT Ethernet protocol is activated

are displayed as Device 1 and Device 2.

2 new I/O devices found	×
☑Device 1 (RT Ethernet) ☑Device 2 (RT Ethernet)	OK Cancel

The system manager will now search the FC9004 channels for boxes (Bus Couplers, Bus Terminal controllers or Fieldbus Box modules).

😎 TwinCAT System Manager	_ 🗆 ×
File Edit Actions View Options He	lp
] 🗅 📂 📽 🔛 🎒 🗛 🛛 X 🖻	🖻 🖻 🖊 🖳 🖴 🗸 🎯 👧 👧 🎨 🔨 🚳 🖹 🔍
🕀 🥵 SYSTEM - Konfiguration	Number Device Type
NC - Configuration	
PLC - Configuration	
🛛 🕎 Cam - Configuration 🛛 🗛 🗛	vinCAT System Manager 🛛 🔀
🖻 🛃 I/O - Configuration	
🚊 🎒 I/O Devices	2 Search for new boxes
🖻 🕮 Device 1 (RT-Ethernet)	
🕀 🎬 Device 2 (RT-Ethernet)	
Appings	<u>Y</u> es <u>N</u> o
Ready	Local Config Mode //

The system manager now wants to activate Free Run mode. Click on Yes.



The system manager will now display the configuration it found:

😎 TwinCAT System Manager						
File Edit Actions View Options Help						
] 🗅 🚅 📽 🔛 🎒 🗛 👗 🛍 🖡		4 🖪 🙃 🗸 🕯	ğ 👧	👧 💱	🔨 🞯	🍫 🖹 🔍
SYSTEM - Configuration	General	Adapter EtherC/	AT Stat	istic Dia	agnosis	
NC - Configuration					_ '	1
PLC - Configuration	<u>N</u> ame	: Device 2 (F	RT-Etherr	net)	Id	1: 2
Cam - Configuration	<u>-</u>	The survey by	inin och (D	(1/ 1)		
E I/O - Configuration	l Type:	Ethernet M	iniport (R	ealtimej		
		ent				
Device 1 (RT-Ethernet)						
Device 2-Process image						
		Disable	Ч		Creat	e sumbols 🗖
Terminal 1 (EK1100)					0,000	
Torminal 2 (EL 1012)	Number	Box Name	Address	Type	Ind. Size	Outp. Size
Terminal 2 (EL1012)	1	Terminal 1 (EK1100)	1	EK1100	0.0	0.0
Terminal 4 (EL 3102)	2	Terminal 2 (EL1012)	2	EL1012	0.2	0.0
Terminal 5 (EL 4102)	3	Terminal 3 (EL2004)	3	EL2004	0.0	0.4
Terminal 6 (EL 5001)	4	Terminal 4 (EL3102)	4	EL3102	6.0	0.0
Terminal 7 (EL9010)	5	Terminal 5 (EL4102)	5	EL4102	0.0	4.0
Terminal 8 (EK1100)		Terminal 6 (EL5001)	6	EL5001	5.0	0.0
Terminal 9 (El 1014)	7	Terminal 7 (EL9010)	7	EL9010	0.0	0.0
	8 0	Terminal 8 (EK1100)	8	EK1100	0.0	0.0
Terminal 11 (EL3142)	10	Terminal 9 (EL1014) Terminal 10 (EL2032)	9 10	EL1014	0.4	0.0
Terminal 12 (EL4132)	11	Terminal 11 (EL3142)	11	EL2032	6.0	0.0
🛨 📲 Terminal 13 (EL1012)	12	Terminal 12 (EL4132)	12	EL4132	0.0	4.0
Terminal 14 (EL9010)	13	Terminal 13 (EL1012)	13	EL1012	0.2	0.0
	14	Terminal 14 (EL9010)	14	EL9010	0.0	0.0
Ready	,				Local	Free Run 🦷

4 Configuration via TwinCAT System Manager

In the left-hand window of the TwinCAT system manager, click on the Ethernet channel you wish to configure (in the example: device 2 (RT Ethernet)).



In the right-window of the TwinCAT system manager, various tabs, i.e.

- General tab
- Adapter tab
- EtherCAT tab
- Statistics tab
- Diagnostics tab

are now available for configuring this Ethernet channel.

	Numbering of the Ethernet channels
Note	The system manager numbers the Ethernet channels (device 1, device 2) in the order in which it recognizes them as ready for real-time Ethernet. This numbering does not have to correspond to the numbering of the LAN connections in the network connections of the Windows Control Panel or the numbering of the RJ45 sockets on the FC900x (X1, X2).
	The channels of an FC9002/FC9004 can be identified via their unique MAC addresses.

4.1 General tab

General Adapt	er EtherCAT Statistics Diagnosis	
<u>N</u> ame: Tupe:	Device 2 (RT-Ethernet)	Id: 1
<u>C</u> omment:		<u> </u>
	☐ <u>D</u> isabled	Create symbols 🗖

Name

The name Device 2 (RT Ethernet) was allocated by the system manager. You may change it.

Туре

Device type.

Comment

Here you can save a free comment text.

Disabled

This control box can be used to disable the Ethernet channel.

Create Symbols

If this control box is activated, the variables can also be accessed via names, although this takes up more memory.

4.2 Adapter tab

General Adapter E	EtherCAT Statistics Diagnosis			
Description:	LAN-Connection 5 (Intel(R) PR0/100 S	LAN-Connection 5 (Intel(R) PRO/100 S Desktop Adapter #4)		
Device name:	\DEVICE\{CCA718F7-064F-4F95-BDB8	-58A8C5DCC8BF}		
MAC Address:	00 01 05 00 00 04	Search		
IP Address:	0.0.0.0 (0.0.0.0)	Compatible Devices		
Free Run Cycle:	5 📮 (ms)			
	Lock I/O after Link Error			
	Fromiscuous Mode (use with Netmon only)			
	Verbose Mode (for Testing only)			
	🔲 No Jitter Mode (for Testing only)			

Description

Shows the number of the LAN connection and the desktop adapter of the Ethernet channel used.

Device name

Shows the Windows device name of the Ethernet channel used.

MAC address

shows the unique MAC address of the Ethernet channel used.

IP address

Shows the IP address of the Ethernet channel used.

Free Run cycle

Here you can specify the cycle time for Free Run mode.

Locking I/O after link error

If this control box is activated, process data exchange is not automatically restarted after a link error has been rectified (e.g. after pulling and reconnecting the network cable). Instead, an I/O reset is required first.

Promiscuous Mode (use with Netmon only)

If this control box is activated, the TwinCAT Ethernet telegrams are also transferred to Windows and can therefore be analyzed with a network monitor (e.g. Etherreal or MS network monitor).

Verbose Mode (for testing only)

In development.

No Jitter Mode (for testing only)

In development.

4.2.1 Compatible Devices

Click on *Compatible Devices* for displaying the TwinCAT-compatible Ethernet devices found on your PC.

TwinCAT Ethernet Compatible Devices	×
✓ 'TwinCAT Ethernet Protocol' installed	Cancel
Installed and ready to use devices:	Show Installation Instructions
TwinCAT-Intel PCI Ethernet Adapter #1 TwinCAT-Intel PCI Ethernet Adapter #2	Open Network Connections
	Install Device
Installed devices but without necessary binding to 'TwinCAT Ethernet Protocol'	
TwinCAT-Intel PCI Ethernet Adapter #3	
Compatible devices with incompatible driver installed:	
Intel(R) PRO/100 S Desktop Adapter #4	

TwinCAT Ethernet protocol installed

This control box indicates whether the TwinCAT protocol driver is already installed.

Installed usable devices

For the fieldbus cards/fieldbus card channels displayed here,

- the TwinCAT driver for real-time Ethernet is installed and
- the TwinCAT Ethernet protocol is activated.

These devices are ready for real-time Ethernet operation.

Installed devices without required binding to TwinCAT Ethernet

For the fieldbus cards/fieldbus card channels displayed here,

- the TwinCAT driver for real-time Ethernet is installed
- but the TwinCAT Ethernet protocol has not yet been activated.

Activate the TwinCAT Ethernet protocol, in order to make these devices ready for real-time Ethernet operation.

Compatible devices with incompatible driver

For the fieldbus cards/fieldbus card channels displayed here,

- the TwinCAT driver for real-time Ethernet is not installed
- and the TwinCAT Ethernet protocol has not yet been activated.

Install the TwinCAT driver for real-time Ethernet and activate the TwinCAT Ethernet protocol, in order to make these devices ready for real-time Ethernet operation.

	Disable Automatic Windows Updates
Attention	The advantage that TwinCAT real-time Ethernet uses standard hardware comes with a small disadvantage: Windows knows this standard hardware, but during a <i>Windows Update</i> or during installation of a <i>Service Packs</i> it will try and install the latest drivers that it considers to be the "best" drivers for this hardware, which means that it may overwrite the TwinCAT driver for real-time Ethernet.
	Remedy: Automatic Windows Updates can be disabled. For manual updates, the suggestion to replace the <i>Intel Networking Driver</i> should not be accepted. After the installation of a Service Pack, the TwinCAT driver for real-time Ethernet should be re-installed and the TwinCAT Ethernet protocol should be reactivated. Readiness for operation of TwinCAT real-time Ethernet can be checked via the <i>TwinCAT Ethernet compatible devices</i> screen.

4.3 EtherCAT tab

General Adapter B	EtherCAT Statis	stics Dia	agnosis				
Net ID:				irtual Ethe	ernet Swito	ch	
Start up to	-		Ma	к Ports:	0		
	SAFE-OF	⁰ '	Ma	k Frames:	0		
· FRE-OF	ve ur		Ma	k MAC Ids	: 0		
				Transpar	ent Mode		
Export Con	figuration File			Disable T	CP/IP Sta	ack	
Frame Cmd	Addr	Len	WC	I Offs	O Offs		
1 LRD	0x00011000	14	8	0			
1 LWR	0x00012000	1	3		0		
1 LRD	0x00040000	1	2				
,							

Net ID

Shows the AMS Net ID.

Start up to

This options field can be used to specify which EtherCAT system state should be activated when the device is switched on: INIT: Initiate PRE-OP: Pre Operation

SAFE-OP: Safe Operation OP: Operation.

Export Configuration File

This button can be used to save the configuration information in an XML file for access from another master system, for example.

Virtual Ethernet Switch

In development.

Display window

Shows the structure of the EtherCAT frames with the commands that were called up.

4.4 Statistics tab

G	eneral Adapter EtherCAT Statisti	cs Diagnosis
	Name	Value
	Sent Frames	305420 (198/s)
	Recv Frames	305420 (202/s)
	Missed Frames	0 (0/s)
	Tc Mode	Real Time Mode
	Sent Utilization (%)	0.1 (R:0.1, N:0.0)
	Recv Utilization (%)	0.1 (R:0.1, N:0.0)
	Reset	

Sent Frames

Shows the number of EtherCAT frames sent and the number of frames sent per second.

Recv Frames

Shows the number of EtherCAT frames received and the number of frames received per second.

Missed Frames

Shows the number of lost EtherCAT frames.

Tc Mode

Shows TwinCAT mode.

4.5 Diagnostics tab

General Adapter EtherCAT Statistics Diagnosis							
	No Ad	ddr Name		State	CRCA	CRC B	CRCC
	1 10)01 Terminal 1 (EK	1100)	OP	0	0	0
	10)02 Terminal 2 (EL	1012)	OP	9	0	0
	📲 3 10)03 Terminal 3 (EL	2004)	OP	3	0	0
	4 10)04 Terminal 4 (EL	3102)	OP	2	0	0
	- 5 10)05 Terminal 5 (EL	4102)	OP	2	0	0
	📲 6 10)06 Terminal 6 (EL	5001)	OP	2	0	0
	10 🔢 📜)07 — Terminal 8 (EK	1100)	OP	0	1	0
	8 10 📲)08 Terminal 9 (EL	1014)	OP	9	1	0
	9 10 📲)09 Terminal 10 (E	L2032)	OP	4	1	0
	📲 10 10)10 Terminal 11 (E	L3142)	OP	3	1	0
	📲 11 10)11 Terminal 12 (E	L4132)	OP	3	1	0
	12 10)12 Terminal 13 (E	L1012)	OP	3	1	0
	Init	Safe-Op	Curre	ent State:	OP		
ļ	Pre-Op	Operational	Req	uested Sta	te: OP		

State

INIT: Initiate PRE-OP: Pre Operation SAFE-OP: Safe Operation OP: Operation.

CRC A

Cyclic Redundancy Check at the incoming EtherCAT connection.

CRC B

Cyclic Redundancy Check at the outgoing EtherCAT connection.

CRC C

Cyclic Redundancy Check at the branch EtherCAT connection (if present).

5 Appendix

5.1 Beckhoff Support & Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

5.1.1 Beckhoff branches and partner companies

Please contact your Beckhoff branch office or partner company for <u>local support and service</u> on Beckhoff products!

The contact addresses for your country can be found in the list of Beckhoff branches and partner companies: <u>www.beckhoff.com</u>.

You will also find further documentation for Beckhoff components there.

5.1.2 Beckhoff headquarters

Beckhoff Automation GmbH Eiserstraße 5 33415 Verl Germany

Phone:	+ 49 (0) 5246 / 963-0
Fax:	+ 49 (0) 5246 / 963-198
e-mail:	info@beckhoff.com

5.1.3 Beckhoff Support

Beckhoff offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- worldwide support
- design, programming and commissioning of complex automation systems
- training program for Beckhoff system components

Hotline:	+ 49 (0) 5246 / 963-157
Fax:	+ 49 (0) 5246 / 963-9157
e-mail:	support@beckhoff.com

5.1.4 Beckhoff Service

The Beckhoff service center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+ 49 (0) 5246 / 963-460
Fax:	+ 49 (0) 5246 / 963-479
e-mail:	service@beckhoff.com

If servicing is required, please quote the project number of your product.