Phoenix Contact's Axiocontroller(AXC) 1050

& Axioline(AXL) F BK PN Manual v0.0.3 Alpha

COLLEGE 1899

By: Daniel Esteves & Joseph Wunderlich PhD

OBS: This manual was developed using PC Worx version 6.30 and AXC(version 3) and AXL(version 2)

Introduction:

Axiocontrollers and Axioline are a line of PLC's produced by Phoenix Contact. It is an Industrial Grade PLC, so it is extremely resistant to impacts but let's not try to break it, ok?

How does the AXC differs from the other PLC's already donated to the College, like the NanoPLC? The answer is that as the Arduino is less reliable or resistant to damage than the NanoPLC, The NanoPLC is less reliable or resistant to damage than the AXC line. In an Industrial environment, errors need to be close to 0, and having a device that can answer to a signal in milliseconds is extremely important.

Security:

If you already played around with a NanoPLC you know that you should use a USB cable to upload a project from NanoNavigator and instantly you get an answer from the device. The AXC line will not work that way. Multiple AXL machines can be connected to a single AXC, but for that to work, it uses Ethernet cables to do this communication. So lets start with the main topic: making the AXC and AXL work together.

PS: This setup requires "expertise" in networking and if you don't know what you are doing, that is totally fine. Just Contact your TA or ITS.

First steps:



1- Connect the power cord to the AXC Trainer 1050 PN (locate as shown below), and turn the switch to the ON (|) mode.



2- Take a second to see the lights blinking and understand the connection between the modules. Check appendix A to see the legend.

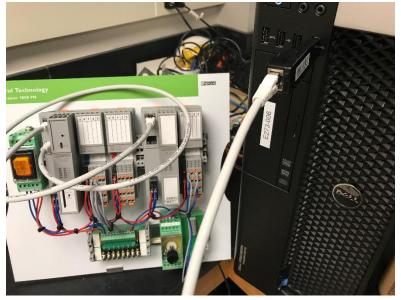
Now we have a functioning PLC, but without any code inside. To upload code, we will have to setup a connection between the AXC and your computer, and that's when things get hard. If you have problems, contact the TA or ITS!

On your computer:

1- Connect a USB-to-Ethernet adapter to the front of your computer.



2- Connect an Ethernet cable from the USB adapter to the X1 port of the AXC.



3- Go on the Control Panel, click on Network and Internet and click on Network and Sharing Center and check the network adapters. One of them should be Ethernet 2 or something like that. Double-click on it and click on Properties. Click on Internet Protocol Version 4 (TCP/IPv4). After selecting it, click in properties, select "Use the following IP address" and enter the value for IP address of 192.168.0.10, for subnet mask 255.255.255.0 and click ok and you can close the other windows.

Internet Protocol Version 4 (TCP/IPv4)	Properties	×
General		
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ODbtain an IP address automatical	ly	
Use the following IP address:		
IP address:	192.168.0.10	
S <u>u</u> bnet mask:	255.255.255.0	
Default gateway:		
Obtain DNS server address autom	natically	
• Use the following DNS server add	resses:	
Preferred DNS server:		
<u>A</u> lternate DNS server:		
Validate settings upon exit	Ad <u>v</u> anced	
	OK Cancel	

Now we have the Adapter and the computer configured to the common range of devices that is the 192.168.0.XXX range. Be mindful that every device to be configured on this manual needs to be in the IP range between 192.168.0.2 and 192.168.0.254.

PC Worx:

- 1- Open PC Worx on your computer. You can click the search box on the bottom of the screen and search for PC WORX and PC Worx 6.30.1668 should show up on the search. If it doesn't, contact your TA.
- 2- Create a new project by clicking file \rightarrow New Project \rightarrow AXC 1050 Rev. > 01/2.10

New Project	×
General AXC 1xxx AXC 3xxx ILC 1xx ILC 2xx ILC 3xx P · ·	OK Cancel
Project Wizard AXC 1050 Rev. > 01/2.00 AXC 1050 Rev. > 01/2.10 AXC 1050/XC Rev. > 01/2.00 AXC 1050/XC Rev. > 01/2.10 AXC CLOUD-PRO Rev. > 01/1.00	

3- To configure the Bus, click on Bus Configuration Workspace, on the Toolbar, click on the AXC 1050 192.168.0.2 that is inside the Bus Structure and click on IP Settings on the Device Details name

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4- Check the IP Address defined to the AXC and the Subnet mask value and see how they reside inside the range of 192.168.0.XXX.

-	: Details J50 192.168.0.2 \IP Settings\	
	Name	Value
ß	Vendor	Phoenix Contact
B	Designation	AXC 1050
B	Functional description	Axioline Controller for Ethernet Networks
B	Device type	PLC
B	Device family	AXC1xxx
B	Order number	2700988
ß	Revision	01/2.10
B	Station Name	
B	Device Name	
B	Module Equipment ID	
B	DNS Name	axc-10501
ß	MAC Address	
ß	IP Address	192.168.0.2
B	Subnetmask	255.255.255.0
B	Default Gateway	

5- VERY IMPORTANT: check the side of your AXC and it should have a MAC address under a barcode. Enter on the defined area (above IP Address) this number on the device.



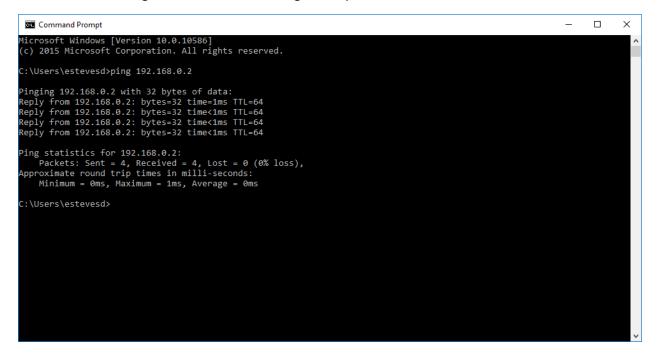
6- Now go to the IP Assignment Tab and it should display 2 devices: AXC and AXL. Click on the one that starts with AXC and click on Assign IP and click refresh to see if the IP Address has changed.

d PROFINET					
Selected PROFINET IO C	Controller				
Name: rfc-4				IP Address: 192.16	8.0.2
Device Type: RFC				Subnet Mask: 255.25	
				Default Gateway:	
Available on Network					
Name	Туре	MAC Address	IP Address	Subnet Mask	
axc-10501	[IOD]: AXC 1050	00:A0:45:41:BA:CB	192.168.0.10	255.255.255.0	
rfc-4701	[IOC]: RFC 470 PN 3TX	00:A0:45:20:3A:44	192.168.0.2	255.255.255.0	
Filter: 🔲 unnamed	🔲 not in Project				
Refresh	Flashing On	Insert			
	2000	evices reachable on the	waiwadd		
		evices reachable on the	: network!		
				Help	Close

- 7- Restart your AXC!!!!
- 8- If the IP was successfully changed, let's go to the next step and we are going to take a break from PCWorx just for a second.

On your computer:

- 1- Press the Windows button on your keyboard and type "cmd" and click on Command Prompt.
- 2- Type without the quotes "ping 192.168.0.xxx". Substitute the xxx by the last digit of the IP address of the AXC. If it gives the following code, you can go to the next step. If not, try rebooting the machine and redoing the steps inside PC Worx.



Back to PCWorx:

- 1- Go to the Communication Tab inside Bus Configuration Workspace.
- 2- Check that the Interface Type is Ethernet, the Connection name is Manual Input, the IP address is the same you used with the ping command above, the subnet mask is 255.255.255.0 and the gateway address is empty and unchecked use virtual LAN.

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: Bus Structure	Device Details AXC 1050 192.168.0.2 \Communication\	+*Q	
 	Interface Type AXC 1030 AXC 1030	Connection Name Manual Input IP Address IS2 158 0 2 V III Subnet Marke Z55 255 255 0 Getway Address V V V V V V V V V V V V V V V V V V	
		Cure virtual LAN Resource: STD_RES	
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For Help, press F1			C: >2GB

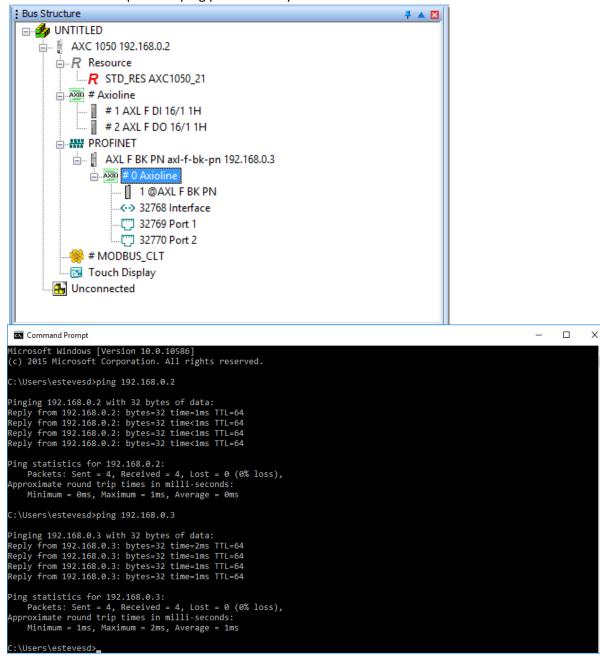
- 3- Click Test and it should display a text inside a green box saying" Host Type: AXC 1050".
- 4- If the above happened, kudos to you!! You did a good job! But it is not over yet...
- 5- Go on the Bus Structure (the top-left box) and right click on Axioline, Read Axioline, OK and you should see the Axioline expanded with #1 and #2.

Bus Structure	7 🔺 🖾

6- Now right-click on PROFINET, Read PROFINET, click on the AXL, click insert, AXL F BK PN 01/1.01, click ok and close the window.

Selected PROFINET IO Controller					
Name: axc-10501			IP Address:	192.168.0.2	
Device Type: AXC 1050			Subnet Mask:	255.255.255.0	
			Default Gateway:		
Available on Network					
Name	Туре		MAC Address	IP Address	Subnet
axc-10501 axl-f-bk-pn	[IOC]: AXC 1050 [IOD]: AXL F BK PN		00:A0:45:9D:67:93 00:A0:45:9D:55:4F	192.168.0.2 192.168.0.3	255.255 255.255
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An unique entry for the folk searched one. Name: axl-f-bk-pn Designation AXL BK PN-ME AXL BK PN-ME AXL BK PN-ME AXL F BK PN XC AXL F BK PN	device	Version 01/1.00 01/1.20 01/1.03 01/1.0	Order Number 2688132 2688132 2701222 2701815	nich matches	Vendor Phoenix Phoenix Phoenix Phoenix

7- You should have everything connected. To make sure, click on the AXL under PROFINET, find its IP address and repeat the ping process that you did with the AXC IP address test.



Finally, Lets Code!!

1- Right next to the Bus Configuration Workspace button there is a button called IEC Programming Workspace. Click on it.

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Bus structure	# 0 Axioline \Axioline Settings\	ce	÷ 🛪 🖪		
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B-R Resource	Name	Value			
R STD RES AXC1050 21	D Vendor	Phoenix Contact	7		
😑 🟧 # Axioline	Designation	AXL F BK PN	-		
#1 AXL F DI 16/1 1H	Functional Description	PROFINET IO - Axioline Bus Coupler	-		
# 2 AXL F DO 16/1 1H	Device Type	Bus Coupler	-		
PROFINET	Device Family	AXLE	-		
	Order number	2701815	-		
🔿 🔊 # 0 Axioline	Revision: HW / Master FW (/COP FW)	01/1.01	-		
- [] 1 @AXL F BK PN	Station Name	01/1101	-		
	Device Name		-		
💭 32769 Port 1	Module Equipment ID		-		
	Number of connectable devices	63	-		
🌞 # MODBUS_CLT	max. current output at UL	without boost terminal (2000 mA)	-		
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2- On Project Tree Window, expand Logical POU's to find Main. Expand Main to find 3 Main. Double-click on the plain Main (without T or V).

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3- As an example we will set up a circuit that will turn an Output HIGH after the 2 Inputs remain HIGH for 7 seconds.

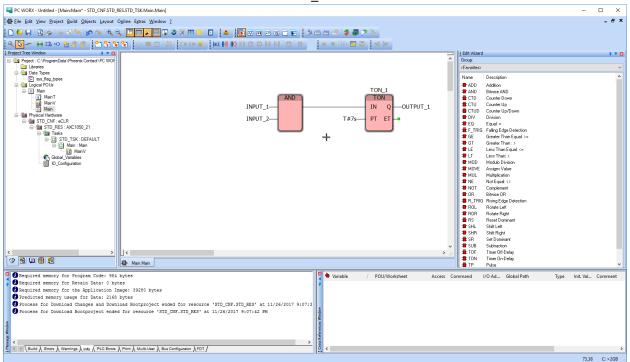
4- On the right part of the window you will find multiple kinds of logic gates. We will use two for this example: 1 AND + 1 TON.

Edit Wizard		₽.▼
Group:		
<favorites></favorites>		
Name	Description	
君 ADD	Addition	
🖅 AND	Bitwise AND	
茸 CTD	Counter Down	
茸 CTU	Counter Up	
茸 CTUD	Counter Up/Down	
📲 DIV	Division	
📲 EQ	Equal: =	
茸 F TRIG	Falling Edge Detection	
📲 GE	Greater Than Equal: >=	
📲 GT	Greater Than : >	
= LE	Less Than Equal: <=	
📲 LT	Less Than: <	
💶 MOD	Modulo Division	
HOVE	Assigns Value	
= MUL	Multiplication	
📲 NE	Not Equal: <>	
🖶 NOT	Complement	
📲 OR	Bitwise OR	
茸 R_TRIG	Rising Edge Detection	
君 ROL	Rotate Left	
君 ROR	Rotate Right	
茸 RS	Reset Dominant	
君 SHL	Shift Left	
💶 SHR	Shift Right	
茸 SR	Set Dominant	
💶 SUB	Subtraction	
茸 TOF	Timer Off-Delay	
≢ TON	Timer On-Delay	
茸 TP	Pulse	

5- Drag the AND gate and drop anywhere you want. Double-click one of the blue terminals. Rename it as "INPUT_1" or something you like. Make sure the Usage is set to VAR_GLOBAL and the data type to BOOL. Repeat that to the second blue terminal but change the name of it.

Variable Properties		×
Name: INPUT_1 Data Type: INT Usage: VAR_GLOBAL Initial value: Initial value: Description:	Definition scope	OK Cancel <u>H</u> elp
<u>PDD</u> OP <u>C</u> <u>H</u> idden <u>Initvalue as default</u> Redundant	Sho <u>w</u> all variables of worksheets Sort by group name	

6- Now drag the TON gate to the right of the AND gate. Do not change anything on it, just click ok. Connect the output of the AND gate to the IN input of the TON gate. Double-click the blue terminal next to PT and name it T#7s. Double click the terminal next to ET and enter the name Actual_Time (Data type: TIME). Double click Q and put the name of the variable you want. MAKE SURE ALL THE VARIABLES ARE IN USAGE MODE VAR_GLOBAL!!!



7- Let's link the variables to the PLC controller lights and switches. Press Process Data Workspace and a 4-window page is going to show up. On the top-left one click on STD_RES:AXC1050_21. This should display some variables on the bottom-left. On the Top-right one Click on the AXC 1050 192.168.0.xxx and some items should be displayed on the bottom-left window.

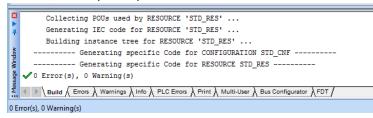
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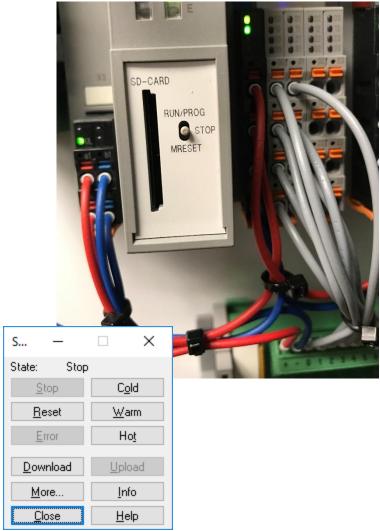
8- Take a look at how the Device separates the matrixes into I(inputs) Q(Outputs). The tables correspond to the same notation on the device. So grab the input you want and drag and drop into the variable. That simple! Repeat that to the second input and for the output but don't use an Input as an output variable, of course.

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NPUT_2	BOOL	# 1 AXL F DI 16/1 1H \ IN01	# 1 AXL F DI 16/1 1H	IN01		BOOL	0.1	STD_CNF STD_RES \ INPUT_2	
UTPUT_1	BOOL	# 2 AXL F DO 16/1 1H \ OUTO	# 1 AXL F DI 16/1 1H	IN02	i	BOOL	0.2		
			# 1 AXL F DI 16/1 1H	IN03	i i	BOOL	0.3		
			# 1 AXL F DI 16/1 1H	IN04		BOOL	0.4		
			# 1 AXL F DI 16/1 1H	IN05		BOOL	0.5		
			# 1 AXL F DI 16/1 1H	IN06		BOOL	0.6		
			# 1 AXL F DI 16/1 1H	IN07		BOOL	0.7		
			# 1 AXL F DI 16/1 1H	INOS		BOOL	1.0		
			# 1 AXL F DI 16/1 1H	IN09	i	BOOL	1.1		
			# 1 AXL F DI 16/1 1H	IN10		BOOL	1.2		
			# 1 AXL F DI 16/1 1H	INTI		BOOL	1.3		
			# 1 AXL F DI 16/1 1H	IN12		BOOL	1.4		
			# 1 AXL F DI 16/1 1H	IN13		BOOL	1.5		
			# 1 AXL F DI 16/1 1H	IN14		BOOL	1.6		
			# 1 AXL F DI 16/1 1H	IN15		BOOL	1.7		
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9- That should be it! Go on Build→Rebuild Project and some comments should show up on the bottom of the page. If you forgot something about the Data Types or Variables that you didn't initialize, it will yell at you.



10- Make sure the device is in the STOP mode by switching it to STOP physically and click Project Control Dialog and click on Download. Just click ok is any problems come up. Allow the PLC to run for a minute.



11- Now switch the device to RUN/PROG and flip the switches that you indicated in the previous steps as input. You can turn on the Debug on/off button and watch everything happening virtually including time counters.

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Required memory for the Application Imag		
Predicted memory usage for Data: 2168 by		
	oad Bootproject ended for resource 'STD_CNF.STD_RES' at 11/26/2017 9:07:3	
	ad Bootproject ended for transure 'JSD CHF.STD FES' at 11/26/2017 9:12:3	
	oad Bootproject ended for resource 'STD_ONF.STD_RES' at 11/26/2017 9:14:0	
Process for Download Changes and Download	oad Bootproject ended for resource 'SID_CNF.SID_BES' at 11/26/2017 9:15:4	
<	Peter à Multi-like à Bus Configuration à PDT /	
The second second second and second and second and second	Luce V manage V an Anademic V.Co. V	100
		55,43 C: >2GB

You just finished programming for an Industrial-Grade PLC.





Appendix:

A) Lights legend

3.5 Diagnostics and status indicators

The diagnostics and status indicators are used for quick local error diagnostics.

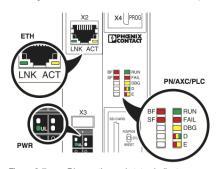


Figure 3-7 Diagnostics and status indicators

Table 3-1 Diagnostics and status indicators of the controller

Desig- nation	Color	Meaning	State	Description
PN: PRO	FINET cont	oller/device function	on	
				AXC 1050 (XC) as a PROFINET controller
		Red Status of PROFINET com- munication/com- munication errors Off On Flashing (1 Hz) Off On	Off	The AXC 1050 (XC) has established an active communication connection to each configured PROFINET device.
			On	No link status at the Ethernet interfaces and/or no 100-Mbit transmission and/or no full-duplex operation.
			· ·	Link status present, at least one configured PROFINET device has no communication connection.
BF	Red			AXC 1050 (XC) as a PROFINET device
			A PROFINET controller has established an active communica- tion connection to the AXC 1050 (XC) (PROFINET device) or the function of the PROFINET device is switched off.	
			On	No PROFINET communication (no link status at the Ethernet in- terfaces).
			Flashing (1 Hz)	Link status present, no communication connection to the PROFINET controller.

8482_de_03

PHOENIX CONTACT 25

AXC 1050 (XC)

Table 3-1	Diagno	stics and status indic	ators of the co	ontroller
Desig- nation	Color	Meaning	State	Description
			AXC 1050	(XC) concurrently operates as a PROFINET controller and device
BF	Red	Status of PROFINET com- munication/com-	Off	The AXC 1050 (XC) (PROFINET controller) has established an active communication connection to each configured PROFINET device and a PROFINET controller has established an active communication connection to the AXC 1050 (XC) (PROFINET device).
		munication errors	On	No link status at the Ethernet interfaces and/or no 100-Mbit transmission and/or no full-duplex operation.
			Flashing (1 Hz)	Link status present, at least one configured PROFINET device has no communication connection or the PROFINET controller has no communication connection.
		Group error	Off	PROFINET diagnostics not present.
SF	Red	(PROFINET)	On	PROFINET diagnostics present.
PLC: con	troller diag	nostics		
		RUN status of the controller	Off	IEC 61131 runtime system not ready to operate.
			Flashing (0.5 Hz)	IEC 61131 runtime system successfully initialized. Control function is in the READY/STOP state, program not pro- cessed.
RUN	Green		Flashing (2 Hz)	Controller reset to default state (see Section "Reset button (concealed)" on page 30).
			On	IEC 61131 runtime system successfully initialized and a pro- gram is running. Control function is in the RUN state.
			On	A runtime error has occurred in the IEC 61131 runtime system program.
FAIL	Red	Failure	Off	No runtime error has occurred in the IEC 61131 runtime system program.
			Flashing (0.5 Hz)	The hardware watchdog of the controller has been triggered.
			On	The IEC 61131 runtime system/controller is in debug mode, i.e., debug mode has been activated in PC Worx (breakpoint(s) set and/or variable(s) forced).
DBG	Yellow	Debug mode		The state of the RUN LED is not affected.
		(troubleshooting)	Flashing (2 Hz)	Boot phase of the controller (from sending the BootP request to assigning the IP address settings) if the MAC address of the controller has been entered in the PC Worx software. Other- wise, flashing stops after three failed boot requests.

 Table 3-1
 Diagnostics and status indicators of the controller

8482_de_03

Description of the AXC 1050 (XC)

Desig- nation	Color	Meaning	State	Description
AXC: Axi	oline F diag	nostics		•
		Green on within the Ax All data is va All data is va Flashing Active: The Axioline within the Ax green Active: The Axioline within the Ax data from the in the device Yellow on Ready: The Axioline The Axioline	Green on	Run: The Axioline F station is ready for operation; communication within the Axioline F station is OK. All data is valid. There is no error.
			· ·	Active: The Axioline F station is ready for operation; communication within the Axioline F station is OK. The data is not valid. Valid data from the controller is not available. There is no malfunctio in the device.
			Ready: The Axioline F station is ready for operation; no data is being exchanged.	
			Flashing Access from Startup+ in I/O cher yellow	Access from Startup+ in I/O check mode
		-	Flashing yellow/red	Local bus error during active I/O check
D	D Red/yel- low/green		Flashing red	 Local bus error during startup Possible causes: Configuration cannot be generated, information is missin from a device Chip version of a device is < V 1.1 Deviation between actual and required configuration No local bus device connected The maximum number of local bus devices has been exceeded Bus error in RUN state The Axioline F station is ready for operation but has lost connection to at least one device.
			Red on	 nection to at least one device. Possible causes: Communication error A local bus device has been removed or a configured device is missing Reset from a local bus device Serious device error at a local bus device (local bus device can no longer be reached)
			Off	Power down: Device is in (power) reset.
Е	Yel-	Error/warning	Yellow on	I/O warning at an Axioline F device
-	low/red		Red on	Peripheral fault at an Axioline F device

PHOENIX CONTACT 27

AXC 1050 (XC)

Table 3-1 Diagnostics and status indicators of the controller Desig-Color Meaning State Description nation PWR: supply voltage (communications power UL) Off 24 V communications power feed-in not present or too low. UL Green ULogic On 24 V communications power feed-in present. ETH: Ethernet interfaces Off Connection not established successfully Connection established successfully (link): the controller is On LNK Link status Green able to contact another network device. Flashing PROFINET device identification "flashing" (0.5 Hz) Off Data transmission inactive ACT Yellow Activity status Data transmission active (activity): the Ethernet interface is On/flashing sending or receiving data



Exception: updates

During an update using FTP or an SD card, the RUN and DBG LEDs flash in alternation. For information about performing updates, please refer to Section "Performing updates" on page 150.



Exception: update using an SD card

Once an update using an SD card is successfully completed, the BF, SF, RUN und FAIL LEDs all flash concurrently at a frequency of 1 Hz.

For information about performing updates using an SD card, please refer to Section "Performing updates via an SD card" on page 150.

8482_de_03

B)