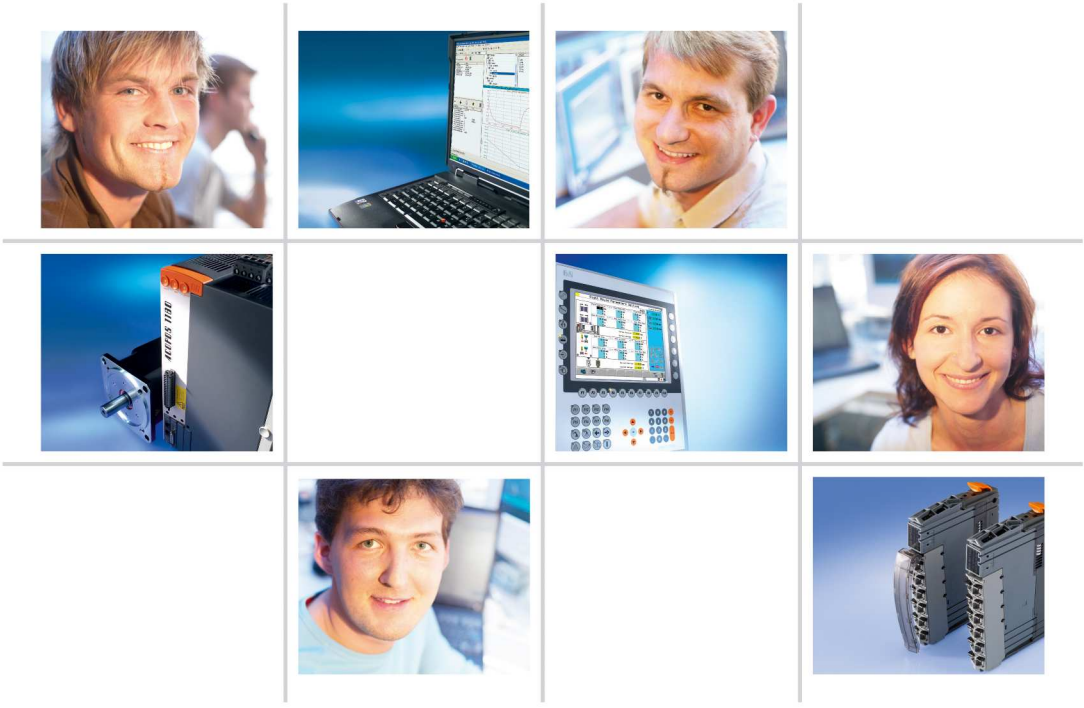
The Service Technician on the Job

TM220



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Requirements

Training modules:	Basic technical training
Software:	None
Hardware:	None

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1. INTRODUCTION

Service technicians have to be ready to work in several different areas. Just about every company needs them to make sure that their machines are running without errors.

Their skills must range from commissioning machines and performing maintenance within defined periods of time to carrying out software updates, replacing hardware, and troubleshooting.

All of these activities in the area of automation can be grouped together under one word – "Service". The title "Service technician" is an umbrella term used for machine assemblers, maintenance personnel, repair staff, etc.

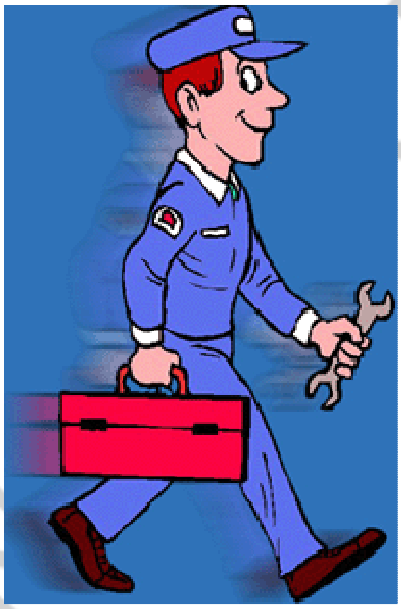


Fig. 1: The service technician

Using situations that correspond to the real world as much as possible, this training module will explain and apply strategies for analyzing errors while describing tools that can be used to correct them.

1.1 Objective

You will learn the different methodologies and tools for a service scenario.

You will become familiar with the B&R product spectrum.

You will become familiar with typical situations and possible procedures to be used in a service scenario.

You will be able to perform extensive service duties.

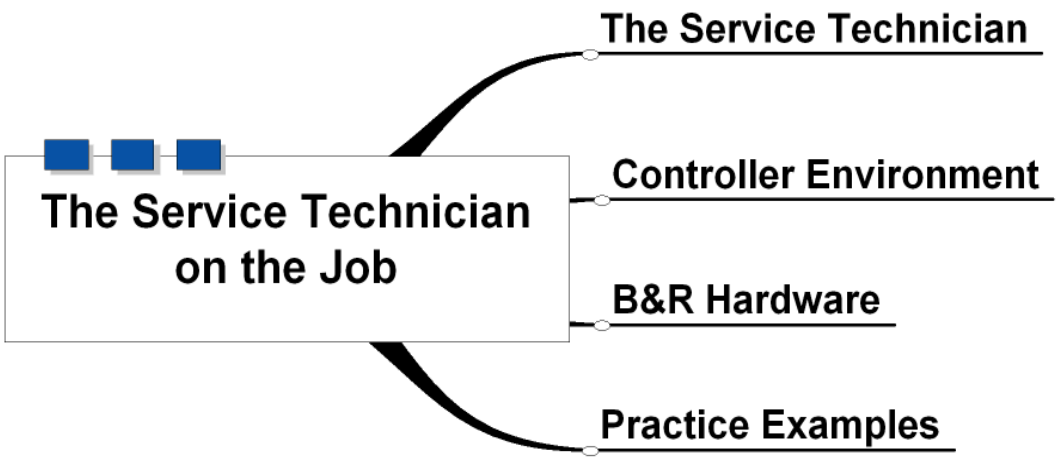


Fig. 2: Overview

2. THE SERVICE TECHNICIAN

Service deployments sometimes have to be planeed very quickly. It is not uncommon to spend a lot of time in cars, airplanes, hotels, as well as at the machine. Service technicians are needed for **maintenance work**, **repairs**, and **on-site** or **factory** service.

2.1 Tasks and skills

Tasks can range from **commissioning** and **maintenance** to **software updates**, **replacing hardware**, or **troubleshooting**.

Service tecnicians must be able to **analyze** and **understand** many different machine and system components as well as **correct** any errors that occur.

Other additional skills include handling customer-oriented assignments, communicating with the customer, and being able to under information from the customer. To prevent misunderstandings, another valuable skill is being able to understand more than one language.

2.2 Role

The number one reason for your being there is to make sure that the machines are running **without errors**. However, you also represent the **link** between the sales team, designers, and machine programmers on the one hand and the end customer on the other. Understanding the product and any possible defective components is also necessary.

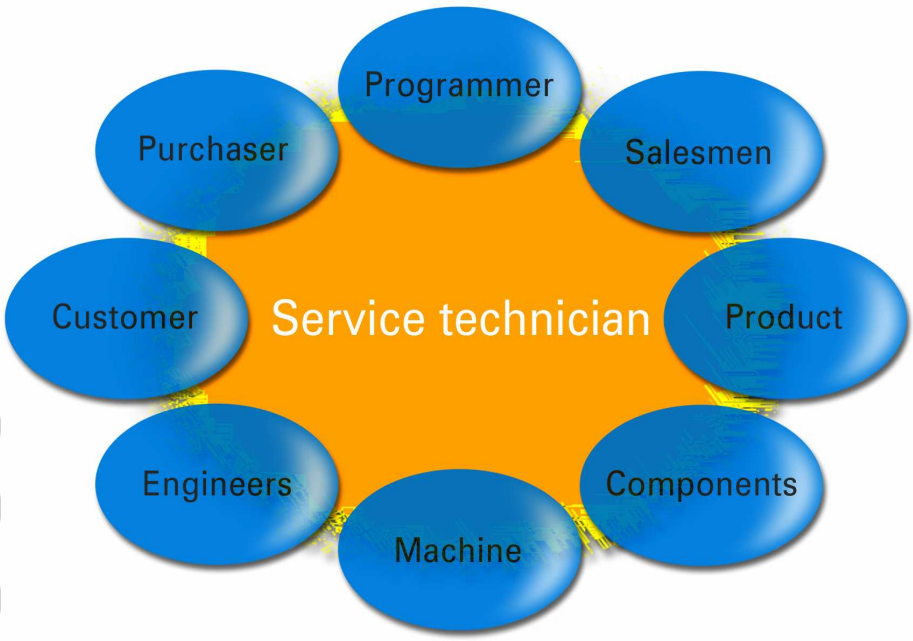


Fig. 3: The service technician's role

2.3 The various scenarios

This training module will cover 5 different scenarios, which have all been mentioned above briefly.

2.3.1 Commissioning

Commissioning ususally takes place according to a defined **acceptance report** so that the functions of the machine can be tested.

Fig. 4: Commissioning

During commissioning, the wiring, mechanics, and hydraulics should all be checked for plausibility. The E-stop circuit and limit switches should also be checked. Proceeding in a step-by-step fashion (activating individual machine parts one after the other) helps avoid errors that may occur during commissioning.

2.3.2 Maintenance

When performing maintenance on a machine, there is usually a **maintenance report** with corresponding instructions from the manufacturer of the machine.

Fig. 5: Maintenance

Maintenance includes the basic checking of the machine's mechanics. In addition, worn parts should be replaced at certain intervals. Proper maintenance also includes checking various fluids (lubricants, oil, etc.).

A programming device can also be used to check the machine's logbook and battery status.

2.3.3 Software update

When updating software, it's important to decide whether the **old software should be backed up**. There are several ways to update software, e.g. from a USB flash drive (must have software to handle this), CD, etc.

Fig. 6: Software update

2.3.4 Replacing hardware

The **I/O system being used** is very important when replacing hardware.

When replacing modules, you need to be familiar with the conditions (e.g. with/without power) under which it's acceptable to replace hardware components.

Fig. 7: Replacing hardware

2.3.5 Troubleshooting

Together with maintenance, troubleshooting probably represents the **most frequent scenario** for a service technician.

Error causes must be narrowed down using the information available together with suitable troubleshooting methodology. Additional aspects of the system must then also be checked so that an error can be precisely localized. The process concludes by **correcting the error**, often with support from the designer or machine programmer.

Fig. 8: Troubleshooting

2.4 Methodology

Diagnosing errors requires the use of certain **methodologies or operating procedures** (e.g. analysis, exclusion, measurements, combining) that allow the targeted used of the available **tools**.

Fig. 9: Detective work

The operating procedure can be compared to that of a detective.

Start with an overview...
Look at the different areas...
Pay close attention to details...
Determine the solution!

> **Note:**
>
> The topic "safety" (your own as well as others and the machine) must always be a top priority during service.

Troubleshooting requires an appropriate working methodology. All possible information and circumstances must be checked out and retrieved, a process that begins in the area around the machine and ends at the controller.

In order to get a **good idea of the error scheme**, it is always necessary to apply common sense. You begin with your questions regarding the circumstances and then get an overview of the overall situation. Once this has been done, you can begin to go into detail by narrowing the error down. This can be done by isolating different sub-areas and carrying out more precise analyses. You can only think about the appropriate tactics and applying the correct **tools** once you have pinpointed the area that you are dealing with.

There are a number of different ways to approach a problem. Unfortunately, there isn't always a set solution in each case. It's usually a **combination** of various strategies for **finding and analyzing errors** that leads to success.

Some additional options include the following:

- Sequential procedure
- Exclusion
- Halving
- Surrounding and general conditions

2.4.1 Sequential procedure

This has to do with a **step-by-step approach**. The sequence is frequently logical, or a checklist is used instead. A step-by-step procedure guarantees if something is working or not.

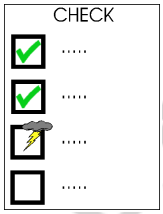


Fig. 10: Sequential procedure

2.4.2 Exclusion

If a machine is composed of several components, then an error in one of them may take the entire machine out of action. Searching for errors is accelerated by **excluding individual machine components**. The remaining parts can be analyzed using more exclusion or other methodologies.

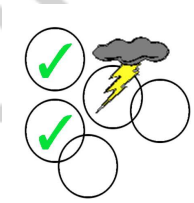


Fig. 11: Exclusion

2.4.3 Halving

A potential error area can be **halved** by making **yes/no decisions**. Applying this methodology several times can considerably minimize the affected area.

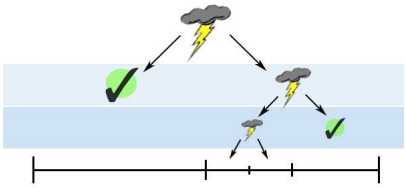


Fig. 12: Halving

2.4.4 Surrounding and general conditions

It's often not such a good idea to try out an analysis strategy immediately since the problem may not have anything to do with the machine directly. When trying to find errors, the surroundings should also be taken into consideration. **Taking all of the machine's environmental conditions into consideration** can help isolate errors that might actually be caused by the surroundings. This is why it's always an advantage to remember to check the general conditions.

Fig. 13: Surroundings

2.4.5 Error scheme

Applying one of the **methodologies** above results in the determination of a certain **error scheme**. This scheme should provide enough provide a clear understanding of the error's **conditions** and **requirements**. The **frequency** and **location** of the error are also decisive factors. Putting together all of the different puzzle pieces results in a precise error scheme for the machine or system. This error scheme can then be used to **develop a solution** to the problem.
The reliability and correctness of the error scheme is vastly important. In this respect, the solution must be compared with the error scheme and the relationship analyzed.

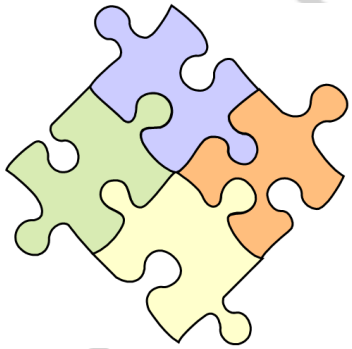


Fig. 14: Error puzzle

3. CONTROLLER ENVIRONMENT

The individual components of the machine are examined more closely to determine if they are causing an error due to possible environmental conditions.

Mechanical effects as well as environmental conditions should be taken into consideration when dealing with any system.

Switches, hydraulics, pneumatics, and motors are often connected with one another, and all of these systems are exposed to the surrounding environment. Environmental conditions, mechanical influences and aging can have significant effects on the function, reaction, and final result of a process.

A number of factors can influence running processes and alter the desired result. Regardless of the error scheme being presented, influences on the machine must always be considered.

Note:

The error sources of the machine elements listed are only examples. The problem does not necessarily have to deal with one of the examples described here.
A solution must be found that corresponds to the options available.

3.1 Switching cabinet, sensors, and actuators

Most machines are equipped with a switching cabinet. The switching cabinet usually contains the controllers, contactors, motor protection switch, fuses, and relays. Controllers for machines that don't have a switching cabinet can be located on a beam, a swivel console, or built directly into the machine base.

Fig. 15: Switching cabinet

Possible error sources:

- Overtemperature (faulty cooling units, incorrect installation)
- Rust, oxidation (dampness, humidity)
- Disconnected plugs, loose connections (vibrations)
- Poor air quality
- Wire breaks of any type (mechanical stress, vibrations)
- Bad terminals
- Defective fuses

Sensors are elements in a machine that pass on information about conditions and circumstances to an intelligent unit (controller) using a particular transfer method.

Fig. 16: E-stop switch

Sensors can be divided into the following groups:

- Digital sensors
- Analog sensors

Possible error sources:

- Age-related contact bounce (mechanical wear on the contacts)
- Sticking contacts (dust, age-related)
- Mechanical wear (shifted switching point)
- Magnetic fields
- Electromagnetic fields (wireless equipment, mobile phones)
- Damaged cables

Actuators are elements of a machine that are controlled by an intelligent mechanism (controller) using a particular transfer method.

Possible error sources:

- Mechanical wear on the contacts (unreliable switching)
- Contact contamination
- Overtemperature
- Overvoltage
- Magnetic fields
- Voltage fluctuations (unstable power mains)
- Damaged cables

Fig. 17: Hydraulic cylinder

3.2 Deterioration and wear

It's not only people who experience a constant aging process; machines also have components that age. Moving parts and components with a high level of mechanical stress are particularly affected, but the deterioration of the other machine components should also never be ignored.

In the course of time, lubricating agents, oil, and coolant fluid may be used up as well.

3.3 Environment influences

The machine's environment exposes it to several different outside influences. These influences can severely disrupt the machine's running processes. Often these are everyday things which are only noticed unconciously.

Possible environment influences include:

- Temperature
- Water, sun, light, snow, ice
- Oxidation, rust
- Vibrations
- Mechanical influences

3.4 Product

Even factors that affect production have an effect on the overall production process. These factors are modified and influenced by the machine operator.

Possible factors:

- Product change
- Tool change
- Material change

3.5 Safety

If safety is not taken into consideration while working, you or others around you may be accidentally injured, standstills may result, or the product may be damaged. Many times, this is due to carelessness or ignorance. Safety must be practiced at all times so as not to place the environment at risk or endanger you or others around you.

Fig. 18: Safety

There are several guidelines and norms that are concerned solely with safety. Certain norms and safety standards **must be adhered to** when dealing with electricity, hydraulics, etc.

Note:

General safety rules in the different areas must be adhered to in all cases. If you are unsure or unaware of something, either find out yourself about it or ask somebody.

Caution:

Never leave a system without restoring it to a safe state. (Remove clamp, bridges, etc.)

3.6 B&R tools

Nowadays, there are several different tools that a technician must use everyday. Being able to use these tools is nearly always a requirement. We're not just talking about tools in the **classic** sense (screwdrivers, multimeters, etc.); **computer-aided** tools that permit additional diagnostics are sometimes even more important.

- Screwdrivers
- Multimeters
- B&R homepage
- Manuals and catalogs
- Serial number
- Automation Runtime
- Automation Studio
- Online help
- Diagnostic options
- PVI Transfer tool

3.6.1 B&R homepage

The B&R hompage contains all of the **useful information** for hardware (e.g. manuals, product overviews, etc.).

The serial number of the hardware module allows you to query additional information over the Internet.

The homepage also lists addresses for all B&R and partner offices worldwide for fast support.

Support queries over the Internet are processed at headquarters in Eggelsberg, Austria.

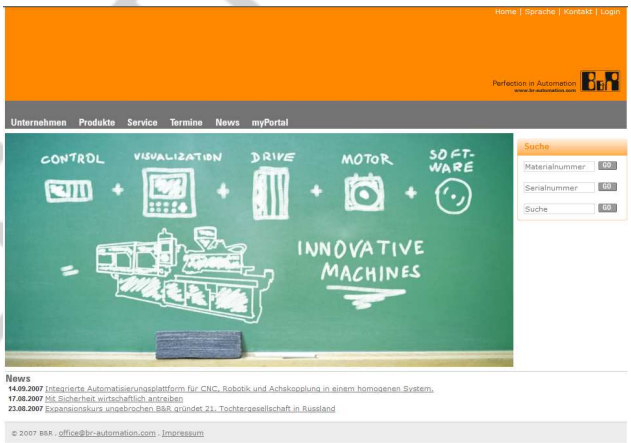


Fig. 19: B&R homepage

3.6.2 Manuals and catalogs

Hardware manuals can be accessed directly from the homepage or found in the Automation Studio online help.

The current **product catalog** is available on **CD** and can also be **downloaded** directly from the **homepage**.

Fig. 20: Manuals and catalogs

3.6.3 Serial number

Every product from B&R is identified with a **sticker** which contains the following module information:

- Model number
- Revision
- Barcode
- Serial number

Fig. 21: Barcode

The **model number** allows you to determine the **system family**.

System family	Family code(s)
2003	7xxxxxx
2005	3xxxxxx
Power Panel	4xxxxxx
APC, IPC, Automation Panel	5xxxxxx
Motion control	8xxxxxx
X20	X20xxxxxx
X67	X67xxxxxx

The type of hardware module can also be determined.

Description	Identification
Analog input module	xxAIxxxx
Digital input module	xxDIxxxx
Analog output module	xxAOxxxx
Digital output module	xxDOxxxx
Analog Mixed Module	xxAMxxxx
Digital mixed module	xxDMxxxx
Temperature module	xxATxxxx
Communication module	xxIFxxxx
Encoder module	xxNCxxxx
Bus controller module	xxBCxxxx
Counter and positioning module	xxDCxxxx
Valve connections	7CXxxx, 7XVxxx, 7XXxxx, X67DVxxx
Motor module	X67MSxxxx

The **revision number** identifies the different versions of the module. A changed revision number usually indicates different firmware versions or the use of other components.

The serial number is saved graphically in the **barcode**. It can be read easily with a barcode reader.

The **serial number** allows the product to be identified precisely, making it possible to also track its history.

Note:

The B&R homepage offers additional information (date of delivery, end of guarantee, etc.) about a product when you enter the serial number.

3.6.4 Automation Runtime

Automation Runtime is the **operating system specific to B&R hardware**. It can be compared to Windows on a PC.

Automation Runtime is a real-time operating system with integrated system monitoring and diagnostic tools.

The operating system provides various diagnostic possibilities that can then be used accordingly as needed.

> **Note:**
>
> Additional information about Automation Runtime can be found in training module TM213 – "Automation Runtime".

3.6.5 Automation Studio

B&R Automation Studio is the integrated **software development environment** that contains tools for all phases of a project. Automation Studio can be used as a development environment for all target systems. Regardless whether controller, positioning, or visualization tasks, it's able to bring everything together in one project: "**One Tool, Many Targets**".

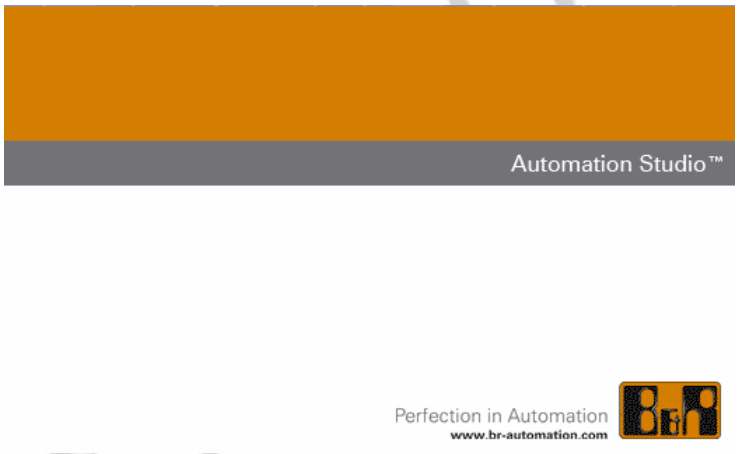


Fig. 22: Automation Studio

> **Note:**
>
> Additional information about Automation Studio can be found in training module TM210 – "Automation Studio".

3.6.6 Online help

The Automation Studio online help can be used as a **reference** when working with Automation Studio, but it can also be very useful for service activities.

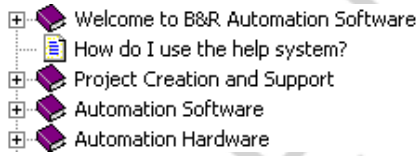


Fig. 23: Online help

The online help contains descriptions of all libraries in Automation Studio as well as information about each individual hardware module in the B&R product spectrum.

> **Note:**
>
> Pressing F1 opens up the help topic for the item highlighted or the library selected.

3.6.7 Diagnostic options

Automation Studio provides several **uniform diagnostics tools** for controller systems.

Some of the most important diagnostic tools include the following:

- Logger / logbook
- Force
- Monitors
- Watch
- Profiler
- Debugger

> **Note:**
>
> Additional information about the different diagnostic options can be found in training module TM223 – "Automation Studio Diagnostics".

3.6.8 PVI Transfer tool

The PVI Transfer tool can be used as an **alternative to Automation Studio**. Although its functions are comparable to those of Automation Studio, it's more limited in that the PVI Transfer tool cannot be used for programming and there are only limited diagnostic options available.

Transfer lists generated in Automation Studio can be opened, edited, and executed from here. There is also the option of creating custom transfer lists (e.g. for a project update).

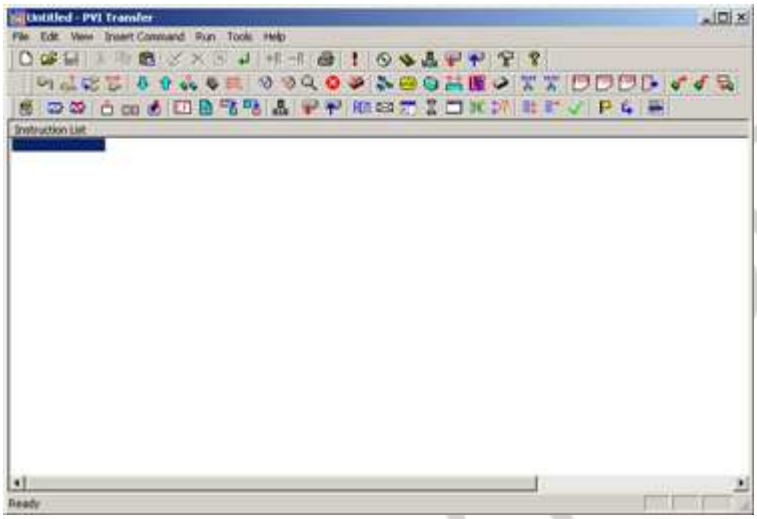


Fig. 24: PVI Transfer tool

Summary:

As you can see, there are several different tools at a service technician's disposal. Not all of them will be used for each service scenario. Rather, their use will depend on the situation at hand.

The error scheme can be completed with these tools.

4. B&R HARDWARE

B&R hardware is used in every aspect of automation engineering. Each industry has its own specific demands, which are covered as completely as possible by B&R. The use of automation components ranges from the smallest rolling gate controller to complex production lines. The existing solutions are just as individual as the range of use is extensive.

At B&R, the field of automation is more than just open- and closed-loop control; instead, it's broken down into the following units:

4.1 Controller systems

Scalable from space-saving, cost-effective machine controllers to large systems with distributed intelligence.

4.1.1 X20 System

The X20 System covers a wide range of demands. It can handle cycle times as fast as 200 μs.

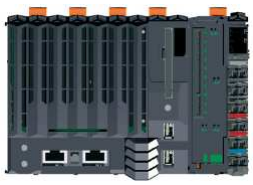


Fig. 25: X20 CPU

4.1.2 System 2003

The System 2003 is a univeral controller system. Distributed controller systems can also be implemented.

Fig. 26: 2003 CPU

4.1.3 System 2005

The System 2005 is an extensive controller from B&R. Its high bandwidth for peripheral signal input and output meets all demands.

Fig. 27: 2005 CPU

4.1.4 Power Panel

Compact and intelligent Power Panel devices are the first choice for automating small to mid-sized machines and systems with maximum component density. Their area of use ranges from simple operator terminals and visualizations with a standard operating system to complete automation systems with integrated control and drive technology.

Fig. 28: Power Panel

4.1.5 Mobile Panel

The Mobile Panel can be seamlessly integrated in the automation solution.

Fig. 29: Mobile Panel

4.2 Industrial PCs

Fully scalable industrial PC solutions for high-performance applications. The display, operating system, and interfaces can be adapted to meet individual demands.

4.2.1 Automation PC APC620

The newest industrial PC generation from B&R. The ACP620 has three housing varieties. The rest of the Automation PC has been kept very modular.

Fig. 30: Automation PC

4.2.2 Panel PC

The Panel PC combines an industrial PC and a display in one housing. The Panel PC and the APC620 are technically based on the same platform.

Fig. 31: Panel PC

4.2.3 IPC 5000

The IPC 5000 is a PC completely tailored for industrial use.

4.3 Visualization and operation

From two-line displays to high-resolution graphics with touch screen.

4.3.1 Power Panel

The Power Panel device can be used either as a controller system or as a pure visualization device.

4.3.2 Mobile Panel

The Mobile Panel device can be used either as a controller system or as a pure visualization device.

4.3.3 Automation PC APC620

The APC620 can be used either as a controller system or as a supporting visualization device.

4.3.4 Panel PC

The Panel PC can be used either as a controller system or as a supporting visualization device.

4.3.5 Automation Panel

Automation Panels are the display units used with the APC620. They can be connected to the APC using an SDL or LDL cable.

Fig. 32: Automation Panel

4.3.6 PANELWARE operator panels

These are compact visualization devices used together with a controller for smaller visualization applications. The visualization program runs on the controller.

Fig. 33: Panelware

4.4 Motion control

Speed and precision to meet the highest demands.

4.4.1 ACOPOS – Intelligent servo drives

Controlling your power transmission system with B&R ACOPOS servo drives allows you to fully use the advantages of an optimized system architecture. Servo drives are used for general positioning tasks, cam profiles, and CNC applications.

Fig. 34: ACOPOS servo drive

4.4.2 Synchronous motors 8MS and 8LS

B&R 8MS and 8LS three-phase synchronous motors have been specially developed for use in high-performance applications.

Fig. 35: Synchronous motors

4.5 Remote I/O systems

Flexibly configured remote I/O systems reduce wiring and can be adapted to fit the surrounding environment.

4.5.1 X20 System – I/O slice system

The X20 System is an intelligent controller and I/O system – locally or remotely. Its flexibility allows it to be used in nearly any application. The user determines the properties, architecture, and topology.

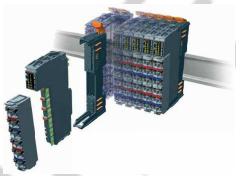


Fig. 36: X20 I/O

4.5.2 X67 System – Remote IP67 I/O

The X67 System is an I/O system for all standard fieldbus systems or for direct connection to B&R controllers. The X67 System consists of bus controller modules, I/O modules, function modules, and system supply modules.

Fig. 37: X67 I/O

4.5.3 Compact I/O systems and valve connections

The space-saving modules of compact I/O systems reduce the wiring of sensors and actuators. Signals are bundled and transferred over the fieldbus to the controller.

Fig. 38: Remote I/O interface

4.5.4 System 2003

Bus controller modules and a large number of input and output modules exist to use the System 2003 as a remote I/O system.

Fig. 39: 2003 I/O

4.5.5 System 2005

System 2005 input and output modules can also be used remotely with bus controllers.

Fig. 40: 2005 I/O

4.6 Network and fieldbus modules

Flexible network and communication options are a hallmark of B&R products. Communication must adapt to meet the requirements of the application (speed, topology, distance). Interface modules are based on the B&R aPCI standard or PCI format.

Fig. 41: interface modules

4.6.1 ETHERNET Powerlink

ETHERNET Powerlink is available as a standard protocol for Fast Ethernet. ETHERNET Powerlink is equally suitable for drives, I/O, and exchanging data between PLC systems.

4.6.2 Profibus DP

Interface cards for Profibus DP masters and slaves are available.

4.6.3 CAN bus

This is the ideal fieldbus for applications with a manageable number of I/O nodes and few axes.

4.6.4 Decentralized backplane

This has to do with the X2X Link.

4.6.5 Serial communication

This deals with interfaces such as RS232, RS422, and RS485.

4.7 Possible configurations

The hardware from B&R makes is possible to implement several different configurations for a machine. From a rolling gate controller to completely linking line systems – anything can be implemented.

The configuration begins by selecting a CPU that's space-saving and that has an integrated visualization unit, high-performance if need be. The bus system to be used depends on the preferred topology, speed, and distance. The I/O system is not a given: once again, it's possible to choose from several different systems. Whether an integrated display or several operator panels, there are no limitations.

4.7.1 System 2003 as a controller system

The configuration in the image below uses a System 2003 CPU in a line system. The CPU controls various sensors and acutators, a visualization unit, servo drives, and remote I/O systems.

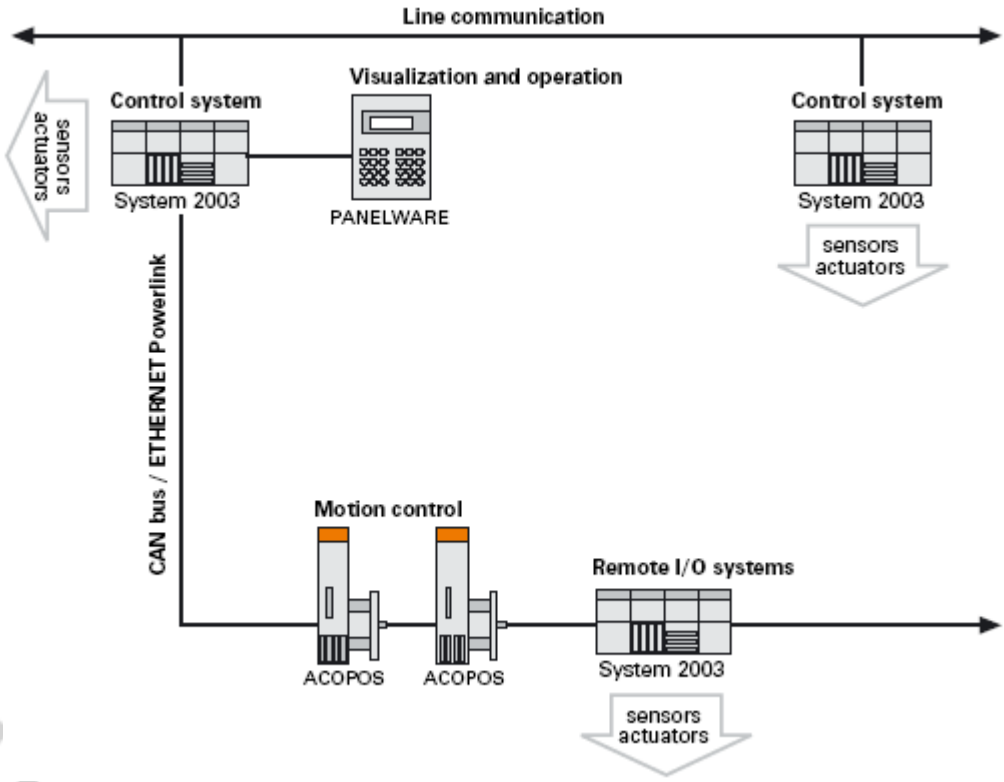


Fig. 42: System 2003 CPU

4.7.2 System 2005 as a controller system

Several System 2005 CPUs are present in this line system. They control various sensors, actuators, servo drives, and remote I/O systems.

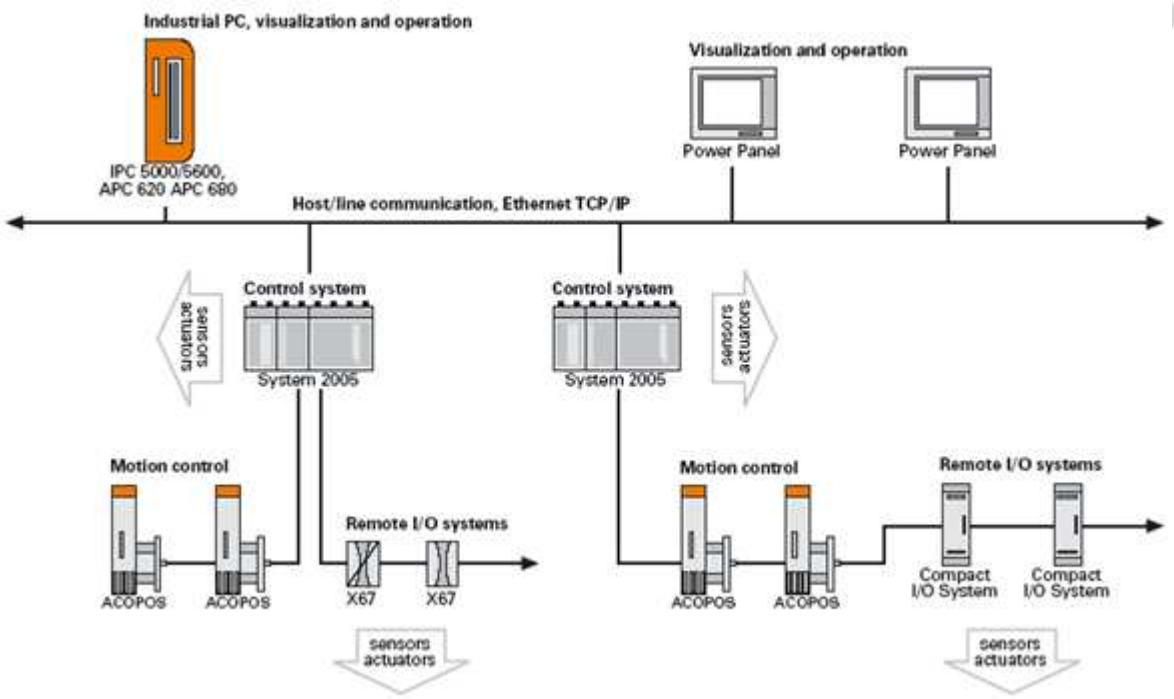


Fig. 43: System 2005 CPU

4.7.3 Power Panel as a controller system

In the example below, a Power Panel device is used simultaneously as the controller system and the visualization unit. The Power Panel controls various remote I/O systems with sensors, actuators, and servo drivers. Several terminals are used in the implementation of the external visualization and control system.

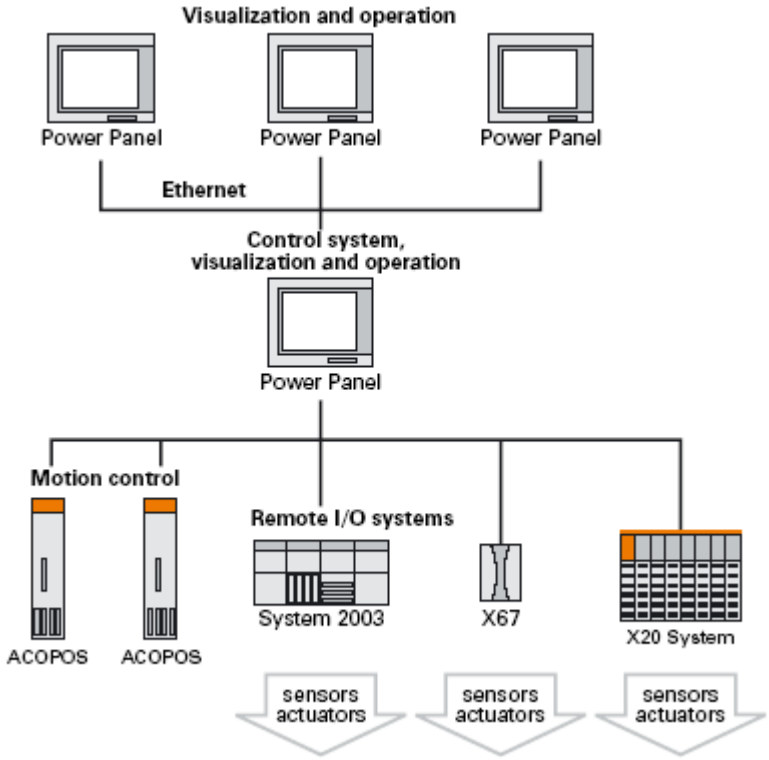


Fig. 44: Power Panel as a CPU

4.7.4 Mobile Panel as a controller system

In this configuration, the Mobile Panel device is used simultaneously as the controller system and the visualization unit. It controls various remote I/O systems with sensors, actuators, and servo drives. In addition, the controller is in a line system.

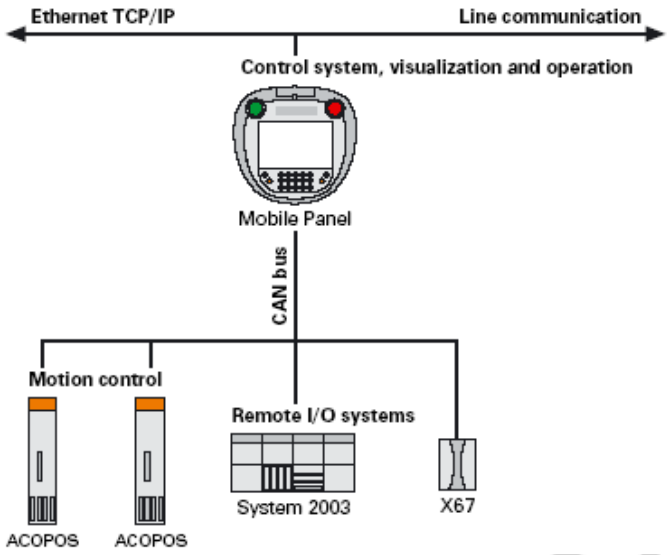


Fig. 45: Mobile Panel as a CPU

4.7.5 APC620 as a controller system

An APC620 Automation PC is used as the controller system. It is used to control diverse remote I/O systems, servo drives, Automation Panels, and several terminals.

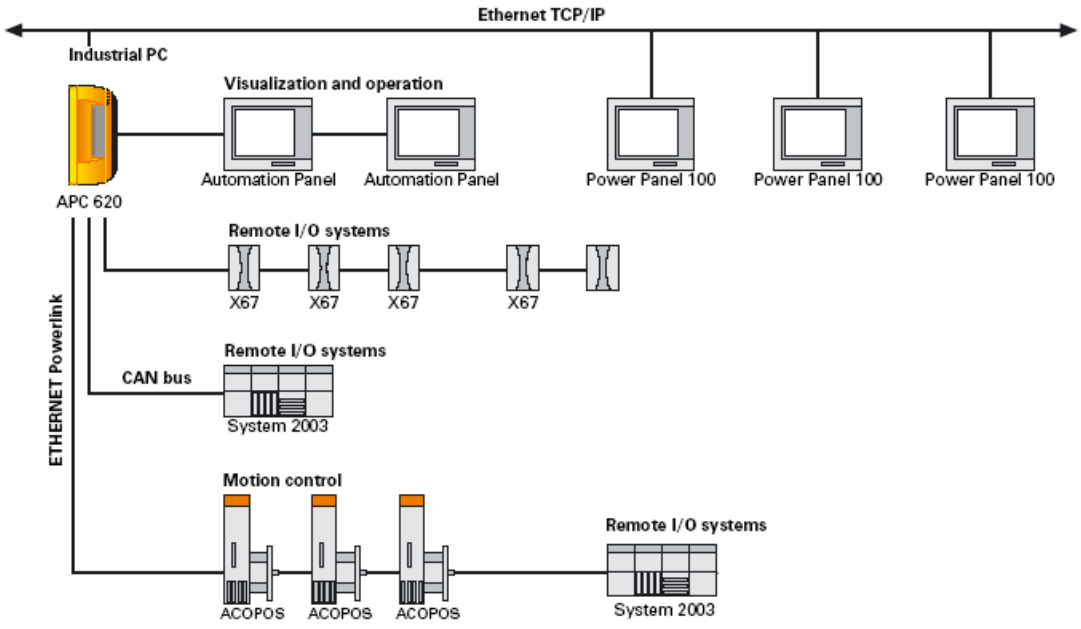


Fig. 46: APC620 as a CPU

4.8 Pin assignments

Each I/O module has a predetermined pin assignment that must be adhered to. Connecting digital modules, analog modules, temperature modules, and communication modules is not always the same.

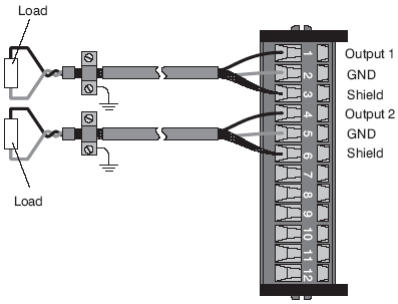


Fig. 47: System 2003 connection

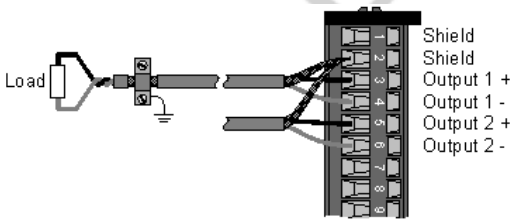
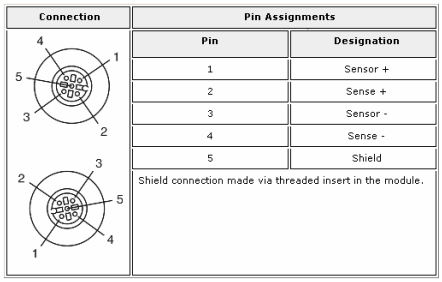


Fig. 48: System 2005 connection



Connection	Pin Assignments	
	Pin	Designation
	1	Sensor +
	2	Sense +
	3	Sensor -
	4	Sense -
	5	Shield
	Shield connection made via threaded insert in the module.	

Fig. 49: System X67 connection

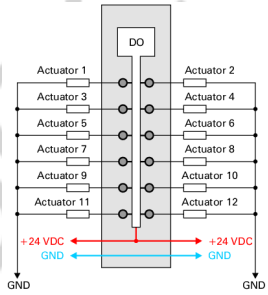


Fig. 50: System X20 connection

4.8.1 Sink and source wiring

Certain modules can be wired as either **sink or source varieties**. Since a module's inputs are normally separated in **electrically isolated groups** of four inputs, it's also possible to wire the individual groups differently.

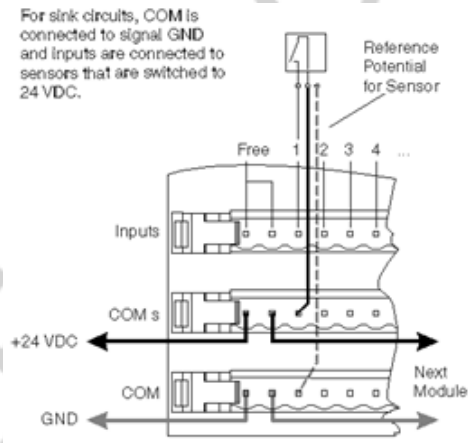


Fig. 51: System 2003 – Sink wiring for a digital input module

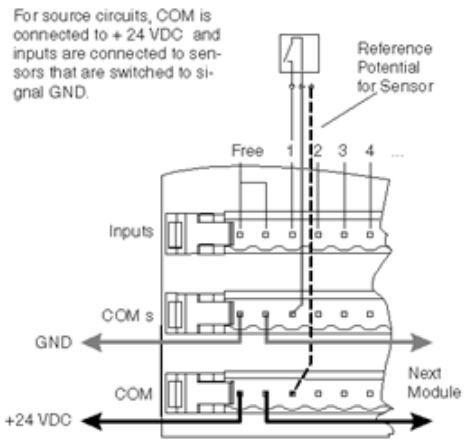


Fig. 52: System 2003 – Source wiring for a digital input module

4.8.2 Connection type

There are two ways to connect a sensor to a temperature module: using a **2-line connection** or a **3-line connection**.

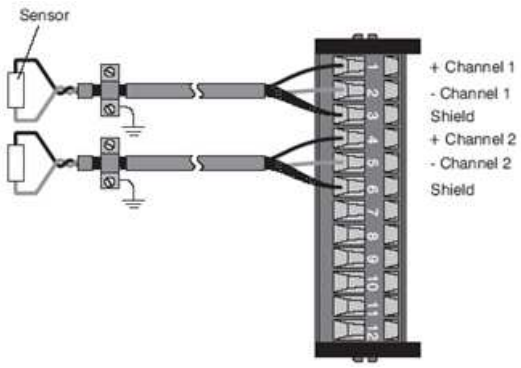


Fig. 53: System 2003 – Temperature module with a 2-line connection

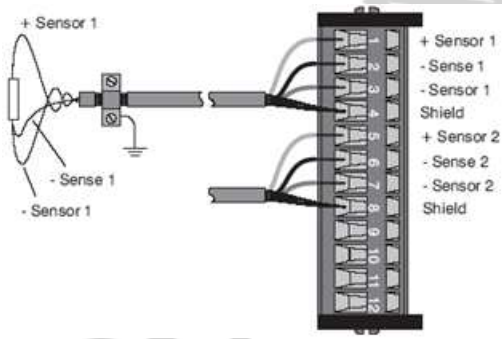


Fig. 54: System 2003 – Temperature module with a 3-line connection

X20 modules can be connected using a **1-line connection**, a **2-line connection**, or a **3-line connection**.

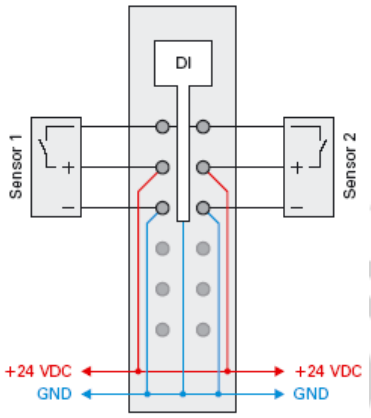


Fig. 55: X20 – 3-line connection

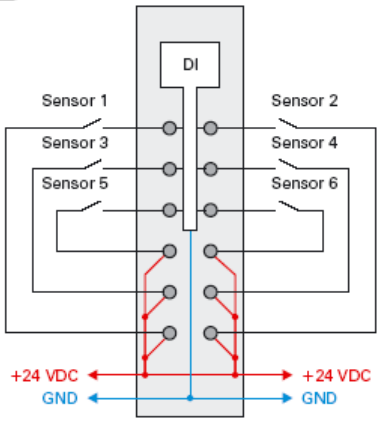


Fig. 56: X20 – 2-line connection

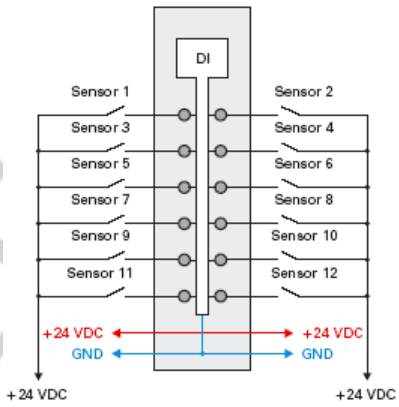


Fig. 57: X20 – 1-line connection

4.8.3 Connection safety

To prevent dangerous mix-ups, X20 modules are **factory-coded**. This coding guarantees that only parts which are permitted to be combined can do so.

There is also **user coding** that prevents terminals from being connected incorrectly.

Fig. 58: Factory coding for X20 modules

Fig. 59: User coding for X20 modules

The plugs for **feeding** and **supplying DC power** for **ACOPOS** servo drives can also be **coded** to prevent dangerous mix-ups.

Note:

Additional information about pin assignments for the individual modules can be found in the corresponding hardware manuals.

Caution:

Make sure that hardware components are properly grounded at all times (more information about this is contained in the hardware manuals) and that the communication cable has the right shielding for the connector.

4.9 Status LEDs

CPUs, I/O modules, and interface cards are equipped with LEDs to indicate their status. They provide information about the operating state, bus communication, or the status of the module. The status of a digital input or output is also indicated by an LED.

Color	Usage
Green	Module status, bus communication, digital input
Red	Module status, bus communication, error
Orange	24 V supply, digital output, communication

Status LEDs provide **information** about the **operating state** or **status** of the individual modules. The **status** of the digital **inputs and outputs** is also displayed.

Status LEDs may take on one of the following states: continuously lit, blinking, quickly blinking twice, and not lit.

4.9.1 CPU

CPUs contain LEDs for the **operating state**, the **battery state**, and **activity** taking place on the **onboard interface(s)**.

Fig. 60: Status LEDs on a CP3xx

LED	Description
READY	CPU active
RUN	Application running
ERROR	SERVICE mode
BAT CPU	CPU battery empty or not present
BAT BUS	Bus battery empty or not present
CF BUSY	CompactFlash BUSY
CF OK	CompactFlash OK
100TX	10/100 Mbaud ETHERNET
ACT/LNK	ETHERNET activity/link

4.9.2 Interface cards

Activity occurring on the individual interfaces is usually indicated with **LEDs**. There are interface cards that have one LED per interface as well as interfaces that indicate all transmission and receiving activity with separate LEDs for each.

Fig. 61: Status LEDs for an RS232 interface

LED	Color	Description
RXD	Continuously orange	Faulty connection or communication error
	Blinking orange	Communication OK (data being received)
TxD	Continuously orange	Faulty connection or communication error
	Blinking orange	Communication OK (data being sent)

Fig. 62: Status LEDs of an ETHERNET Powerlink interface

LED	Color	Description
RXD	Orange	Always lit when Powerlink activity is taking place on the bus
TxD	Orange	Lit if the Powerlink station is sending data
L/C	Red/Green	Red.....Collision Green.....Link
Status	Red/Green	Status of the Powerlink station

4.9.3 I/O modules

A set **digital input** is indicated by a **green (lit) LED or number**. A **digital output** is indicated by a **yellow (lit) LED or a number**. In addition, some modules have a **status LED** for the **24 V supply** for the bus connection.

Note:

The status LEDs of individual modules are clearly documented in the hardware manuals.

Note:

It's not out of the question for a digital output to be set even if the respective LED isn't lit, e.g. if the LED is defective.
If the module isn't correctly supplied when an output is set, the output LED blinks, but no voltage is output.

4.10 Node switches, operating mode switches, and reset buttons

CPUs and communicatoin modules often have buttons or switches that can be pressed or set.

4.10.1 Node switches

There are frequently two switches for setting the **node number** on the CPU and communication modules. The node number is used to **address** the controller from Automation Studio and can be used to **communicate** in a line system.

Fig. 63: Node switches

Switch position		Function	Description
0	0	Boot	Automation Runtime boot mode for operating system upgrade
0 to F	0 to F	Node	01-FD can be used freely by the user (node number for online communication).
F	E	Dyn. node	The device address can be defined by the software.
F	F	Diagnostics	Diagnostics mode

Note:

Each node number can only be assigned once in a network.

Caution:

Certain node switch positions are reserved for special operating states.

4.10.2 Operating mode switch

In addition to the node switches, some CPUs (e.g. CP570, X20, CP380) have a **switch** for the **operating mode**.

On Power Panel devices, the operating mode is set automatically using the node number.

Switch position	Operating mode	Description
0	Boot	Automation Runtime boot mode for operating system upgrade
4	Run	RUN mode
F	Diagnostics	Diagnostics mode

4.10.3 Reset button

The **reset button** can be pressed with a pointed object. The reset button on the CPU is located differently depending on the controller. The operating state to be set after pressing it can be **configured in Automation Studio**.

4.11 Data buffering and memory

A lithium battery ensures the **buffering** of the **internal real-time clock**, **User RAM** and **System RAM data**, and **remanent variables**. The battery status can be **queried using software**.

Caution:

If you are using remanent or permanent variables and buffering is no longer working, your data will be lost after a cold or warm restart.

Note:

How to change the battery is explained in the respective hardware manuals.

System 2003 CPUs generally have **User RAM**, **System PROM**, and **USER PROM** available for **memory**. File handling is only possible with limitations.

Other controller systems usually have RAM, User RAM, and an additional **CompactFlash** interface. Required files (with any extensions) can be stored on the CompactFlash card and retrieved from the controller using FTP.

Summary:

There are several different ways to implement a machine configuration using B&R hardware. The controller system, the I/O system, and the operator devices can be adapted precisely to the needs of the user.

The exact status can be determined using the hardware status LEDs.

5. TYPICAL SITUATIONS

The following information contains useful tips for a service scenario. The examples listed should not be used as a sole reference; they are only listed to provide support.

5.1 Commissioning

Commissioning is the first contact the service technician has with a new machine at the customer's site. Commissioning is usually performed according to a certain **acceptance report**, where the machine has been thoroughly tested with the customer.

Note the following items during commissioning
Visual examination of the machine
Check wiring (communication cables), mechanics, and hydraulics
Check E-stop circuit and limit switches
I/O tests on the machine (E-stop, limit switches, etc.)
Download project with the CPU in service mode if possible
Module test, i.e. test individual machine components separately

5.2 Maintenance

There is usually a **maintenance report** used for maintaining the machine. For this reason, there is no **permanently defined operating procedure** since it depends on the machine type and hardware being used.

Note the following items during maintenance
Check the various fluids
Read and analyze the logbook / logger
Check the battery status

5.3 Software update

A software update usually must be performed if a software error has been corrected or a new function has been integrated.

When updating software, it may be necessary to **back up the old software**.

Several options for making a backup
Copy the contents of the CompactFlash card to the computer using a card reader
Create a backup of the CompactFlash with the PVI Transfer tool
Use the backup function integrated in the project (e.g. a backup in a folder on the CompactFlash card or a USB flash drive).

To **perform the update**, there are once again several options available. The basic criteria is decided which possibilities you have for making an update (with a programming device, PC only, etc.). You also have to find out whether the **operating system must be updated as well**.

Several options for updating
Integrating an update function in the project (e.g. updating from a USB flash drive)
Creating an update CD in the PVI Transfer tool
Updating directly from Automation Studio
Creating a transfer list that can be transferred to the controller with the PVI Transfer tool

5.4 Replacing hardware

The **I/O system being used** is always very important when replacing hardware. You must always know the circumstances under which a module can be replaced. The circumstances are also important when replacing an entire slave. After the hardware has been replaced, make sure that the modules' wiring has been restored correctly.

To note when replacing hardware
System 2003 screw-in modules (e.g. AT352) can be replaced without a bus failure.
While replacing an X67 module, the entire bus behind it fails.
X20 modules can be replaced with no problems during operation.

5.5 Troubleshooting

The customer usually sends a direct message to their sales representative or service technician stating that a machine has an **error** or a **problem**.

The service technician then gets into contact with the customer to find out **more information**. Once the circumstances have been cleared up, a decision can be made as to whether service should take place on-site or whether support can be provided remotely.

Last of all, a **connection** to the controller can be made so that the logbook can be checked and analyzed. The logbook allows you to determine straightaway whether you're dealing with a **system error** (e.g. cycle time violation, exception page fault, defective module) or a programming error (e.g. the machine isn't responding correctly when a button is pressed).

If a module is no longer detected by the system (a message is entered in the logbook for this), the connection to the respective module should be checked and, if necessary, replaced. If you're dealing with a cycle time violation, the logger **backtrace** function can be used to determine the last executed action. The **profiler tool** can also be started to get more precise information about the load on the controller.

For the **diagnostic tools** mentioned above, you will need Automation Studio. If you only have access to the PVI Transfer tool, you can still upload the controller's logbook, but it will not be possible to carry out a backtrace or profiler measurement.

A **more precise error analysis or error localization** can then take place in the project. Once again, Automation Studio provides different tools for this such as Watch, Trace, and monitor mode.

If you're dealing with a **programming error**, there are several different ways to localize it. These options are again very strongly dependent on the tool being used. Watch, Trace, and monitor mode are available in Automation Studio.

Once the error or problem has been found, it can be **corrected** with the available tools. If the project's software needs to be changed, then a **software update** needs to be carried out.

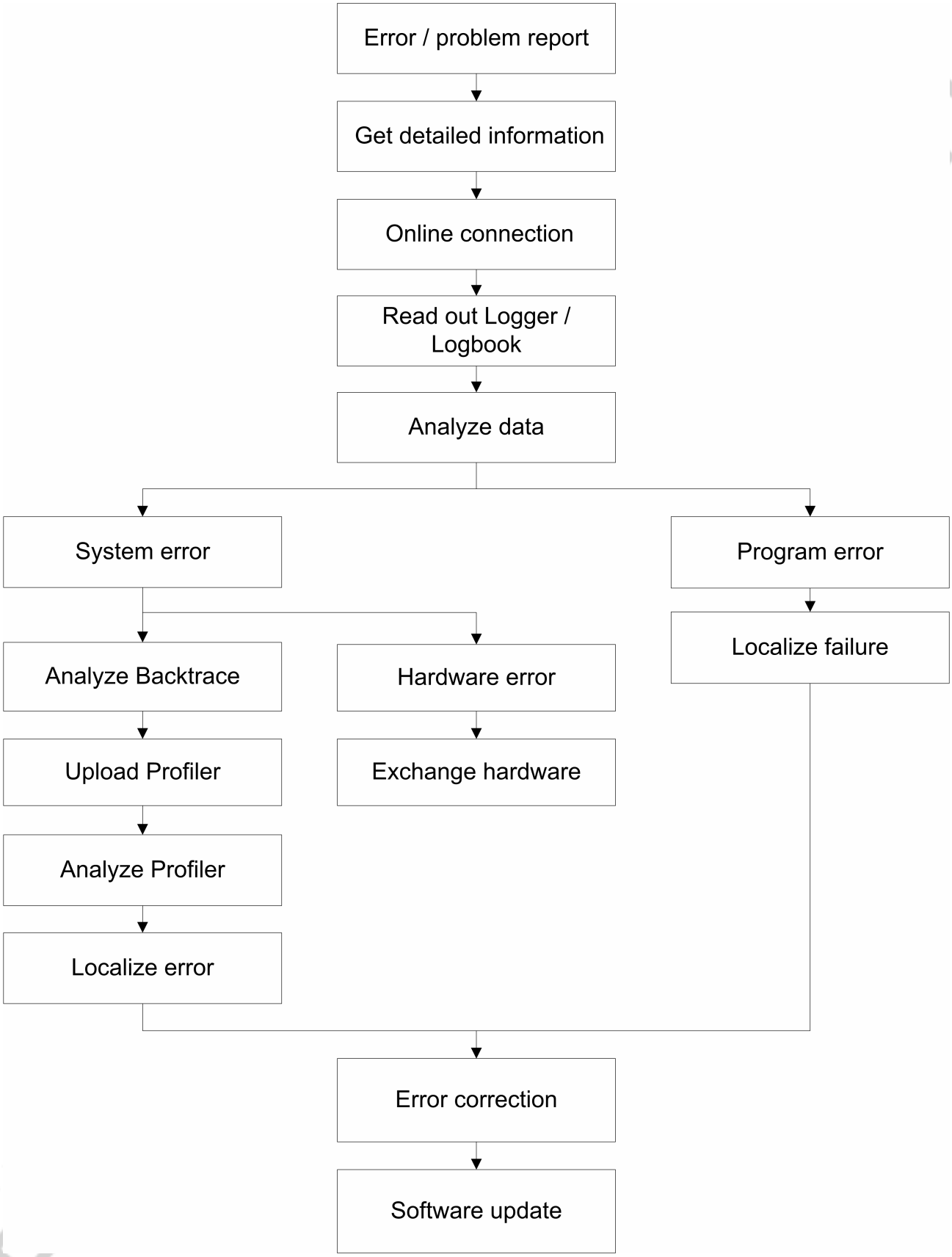


Fig. 64: Possible procedure for troubleshooting

Note:

More information can be found in the training modules
TM210 – "The Basics of Automation Studio",
TM211 – "Automation Studio Online Communication", and
TM223 – "Automation Studio Diagnostics".

Exercise: Get an overview

Use the homepage to find information and manuals for the hardware in your rack.

Enter the serial number from one of your hardware modules on the homepage.

Browse through the Automation Studio online help to find information about the hardware in your rack.

Use the PVI Transfer tool to get information about your hardware (CPU type, hardware info, etc.).

Make the system crash and analyze the logbook.

6. SUMMARY

Now we've takes a very good look at a service technician employed in the field of automation.
As a representative of his company at the customer's location, the service technician is the link between the end customer and his company.
This training module is to be used as support during a service scenario.

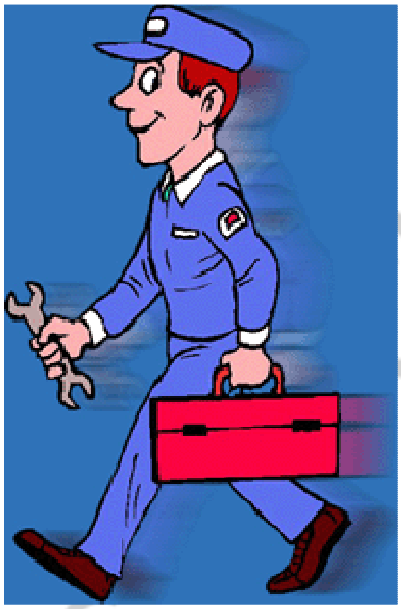


Fig. 65: The service technician

You should understand how to employ the correct methodologies and how to use the available tools to the best of their potential.

Essential tasks include commissioning, maintenance, software updates, replacing hardware, and troubleshooting.

Overview of training modules

TM200 – B&R Company Presentation **
TM201 – B&R Product Spectrum **
TM210 – The Basics of Automation Studio
TM211 – Automation Studio Online Communication
TM212 – Automation Target **
TM213 – Automation Runtime
TM220 – The Service Technician on the Job
TM223 – Automation Studio Diagnostics
TM230 – Structured Software Generation
TM240 – Ladder Diagram (LAD)
TM241 – Function Block Diagram (FBD)
TM246 – Structured Text (ST)
TM247 – Automation Basic (AB)
TM248 – ANSI C
TM250 – Memory Management and Data Storage
TM260 – Automation Studio Libraries I
TM261 – Closed Loop Control with LOOPCONR

TM400 – The Basics of Motion Control
TM410 – The Basics of ASiM
TM440 – ASiM Basic Functions
TM441 – ASiM Multi-Axis Functions
TM445 – ACOPOS ACP10 Software
TM450 – ACOPOS Control Concept and Adjustment
TM460 – Starting up Motors

TM500 – The Basics of Integrated Safety Technology
TM510 – ASiST SafeDESIGNER

TM600 – The Basics of Visualization
TM610 – The Basics of ASiV
TM630 – Visualization Programming Guide
TM640 – ASiV Alarm System
TM650 – ASiV Internationalization
TM660 – ASiV Remote
TM670 – ASiV Advanced

TM700 – Automation Net PVI
TM710 – PVI Communication
TM711 – PVI DLL Programming
TM712 – PVIServices
TM730 – PVI OPC

TM800 – APROL System Concept
TM810 – APROL Setup, Configuration and Recovery
TM811 – APROL Runtime System
TM812 – APROL Operator Management
TM813 – APROL XML Queries and Audit Trail
TM830 – APROL Project Engineering
TM840 – APROL Parameter Management and Recipes
TM850 – APROL Controller Configuration and INA
TM860 – APROL Library Engineering
TM865 – APROL Library Guide Book
TM870 – APROL Python Programming
TM890 – The Basics of LINUX

**) see Product Catalog

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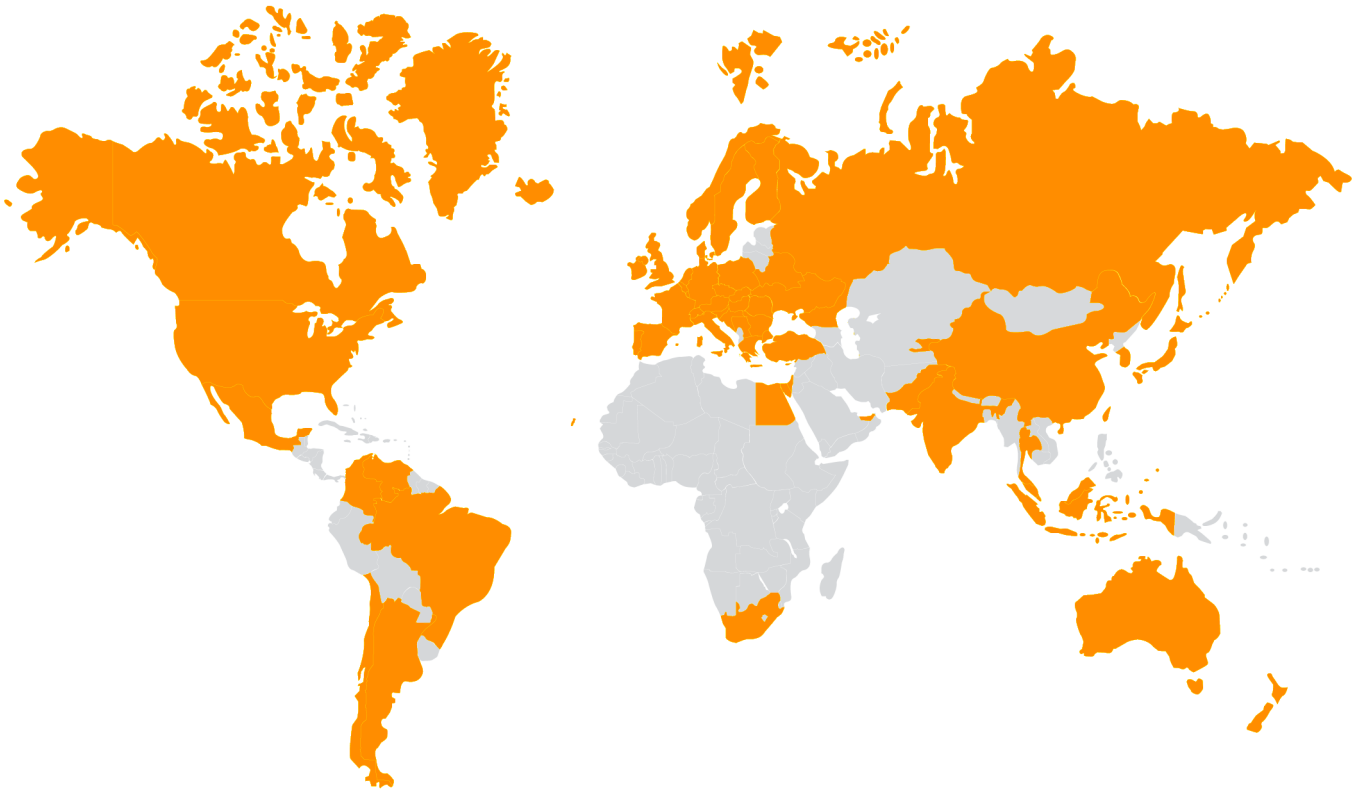

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