B&R SYSTEM 2000

B&R 2010
USER'S MANUAL

Version: **1.0 (Feb. 2000)**
Model No.: **MASYS22010-E**

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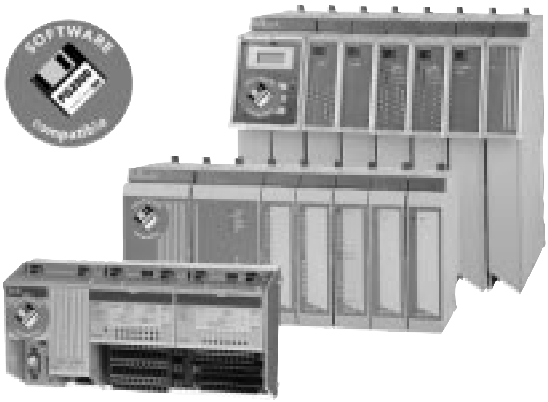
CHAPTER 1
GENERAL INFORMATION

1 INTRODUCTION

1.1 GENERAL INFORMATION

The controller generation B&R system 2000 is an automation system that sets new standards in performance, functionality and operational safety. The systems B&R 2003, B&R 2005 and B&R 2010 cover the entire application range from simple logic processors to complex, decentralized, divided, automation systems. Each system differs in structure, assembly, modularity and CPU performance. They are, however, so closely related that programmer compatibility is ensured and the basic objectives of fully centralized and decentralized compatibility are provided.



Features of the B&R 2010 PCC Family

Hardware:

- Modular Hardware
- Network Capability
- Communication Interface to HMI
- PCC and Industrial Computer Functionality
- EMC according to IEC 61131-2
- Secure I/O Bus Protocol
- Remote I/O Points
- Separate I/O and Industrial Computer Bus System
- Bit or Word Processing in One Cycle
- Higher Performance with Multiple I/O Bus Systems
- Industrial Terminal Blocks

Software:

- Multitasking Operating System for PCC and Industrial Computer Applications
- High Performance PCC Programming Languages
- High Level Language Programming
- Exact Control over PCC Timing
- Simple Programming Software with Window Oriented Desktop
- Project Management within Programming Software

PCC (Programmable Computer Controller)

The PCC kernel is a powerful standard system component. The advantage is that these microprocessors offer high performance today and also allow new high performance kernels to be integrated into the system in the future. The kernel in complemented by a RISC processor for external communication and therefore reduces the load on the CPU. Communication with the serial interfaces takes place parallel to the actual operation of the main processor. This does away with communication bottlenecks that often occur in conventional systems. Function blocks which enable the functionality of an industrial PCC work within the kernel. Bit, byte and word access are possible in a single cycle, which increases the speed because PCC connections and industrial computer functionality are combined.

A further bottleneck in conventional PCC systems is the bus system with which the all data transfer takes place. In the B&R 2000 PCC Family, a completely new bus concept is used which is based on the separation of the system bus and I/O bus. Modules that are required for industrial computer functionality operate on the system bus, e.g. mass memory controller, additional processor modules, remote master, network modules etc. Naturally, the system bus is also multiprocessor capable. The I/O bus takes care of the modules that are used to interface the machine/system, e.g. digital and analog I/O modules, positioning modules, intelligent I/O processors etc.
The main feature of the I/O bus are:

- Parallel data transfer
- Secure protocol
- High data throughput rate

<u>Parallel Data Transfer</u>

Most conventional PLC systems work with a process image in the CPU memory. That means the input signal required for program execution has to be copied to the CPU at the beginning of each cycle. After the cycle has been executed, the states of the outputs are copied from the CPU to the output modules. Naturally, this procedure loads the PLC CPU since a part of the CPU time is used to copy the I/O signals.

In the B&R 2000 PCC Family, the data necessary for the process image is copied parallel by components developed specifically for this purpose (I/O processors).

<u>Secure Protocol</u>

Data transfer on the I/O bus is protocol secured. This guarantees that no incorrect I/O information is exchanged between I/O modules and the PCC CPU.

<u>High Data Throughput Rate</u>

The data throughput rate is high enough to guarantee parallel creation of the process image in complex applications (more than a thousand I/O points). All I/O data is guaranteed to be provided when needed, even in the future with more powerful processor kernels. An additional increase in efficiency is planned with the setup of multiple bus systems.

Equipment Interface

The equipment interface represents all I/O modules and also the interface between the PCC and the machine or equipment being controlled. All I/O modules in the B&R 2000 PLC family are electrically isolated and protected by EMC measures against external disturbances (Standard IEC 61131-2). The I/O modules are encased in plastic housing so that the technician does not come in contact with the electronics during installation.

The length and structure of the I/O buses are extremely flexible and can be arranged to suit the machine or equipment, i.e. the connections for the I/O signals are not necessarily in the same place as the PCC CPU. By combining local and remote I/O bus segments, the optimal structure can be created to suit each individual application. I/O modules are installed near the machine or equipment, where they are needed. Cabling to the PCC kernel is reduced to a two wire line or optical fibre.

The B&R PCC family has terminal blocks which were especially designed for the requirements of a tough industrial environment. These requirements include:

- Large number of connections in a small space
- Simple insertion and removal (quick lock)
- Software monitoring of the contacts
- Protection against plugging in the wrong terminal block

The terminal block for a B&R 2010 system can have up to 40 wires connected, each having a maximum cross sectional area of 2.5 mm^2 (14 AWG). It is easy to unplug with the built-in ejection lever as well as a coding mechanism to prevent inserting the wrong terminal block. An LED status indicator on the module shows if the terminal block is inserted correctly. This information is also available to the application program.

Industrial Computer

Separating of the I/O and system bus allows the addition of industrial computer functionality without loading the equipment interface (I/O bus). The system bus is capable of handling multiprocessors and additional CPU modules for added workloads.

Networking

Networking and the ability to communicate with other systems are a must for industrial control today. The B&R 2000 PCC family provides for all current communication requirements through system variety and the ability to interface with other systems.

Software Concept

Much emphasis has been placed on the fact that the software must be easy to use and program. Standard PLC programs run cyclically, i.e. the program is repeatedly executed in a loop. To increase program efficiency, the B&R 2000 system also offers the possibility to divide the application into many tasks with different cycle times. Time critical program sections (e.g. reaction to trigger signals) can be processed faster and more often than slower events (e.g. keyboard requests).

Programming

The programming software is a complete package which runs on a standard DOS PC. The operating environment has all the user friendly characteristics of modern software, e.g. window system, pull-down menus and a context sensitive help system. You can control the software with the keyboard and/or the mouse. In addition to the standard programming languages, ladder diagrams, logic diagrams and statement list (conforming to IEC 61131-2 standards), a powerful, high level language - PL2000 has been specially developed.

1.2 STANDARDS FULFILLED BY THE B&R 2000 CONTROL GENERATION

In general, the B&R 2000 control generation is designed to conform to product standard IEC 61131-2. The following standards provide detailed definitions required for proper operation in a typical environment containing electromagnetic charges.

Standard	Description
IEC 50081-2 IEC 61000-6-4	Electromagnetic compatibility (EMC) Part 2, Generic standards - Section 4: Emission standard for industrial environments. (IEC 50081-2 is replaced by IEC 61000-6-4)
IEC 50082-2 IEC 61000-6-2	Electromagnetic compatibility (EMC) - Part 2, Generic standards - Immunity for industrial environments- (IEC 50082-2 is replaced by IEC 61000-6-2)
IEC 55022	Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement
IEC 55024	Information technology equipment. Immunity characteristics. Limits and methods of measurement
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 : General requirements
IEC 60950	Safety of information technology equipment
IEC 61000-3-2	Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current <= 16 A per phase)
IEC 61000-3-3	Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <= 16 A
IEC 61131-2	Programmable controllers - Part 2: Equipment requirements and tests
IEC 61800-3	Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods
UL 508	Industrial Control Equipment, (UL = Underwriters Laboratories)

Limits

IEC 61000-4-2 Electrostatic Discharge		
	IEC 61131-2	**B&R Value Limit**
Contact discharge to powdered and blank metal parts	4 kV	8 kV
Discharge through the air to plastic parts	8 kV	15 kV

IEC 61000-4-3 Electromagnetic Fields	
Housing, completely wired:	80 MHz - 1 GHz, 10 V/m, 80 % amplitude modulation with 1 kHz

IEC 61000-4-4 Burst (asymmetric fast transient)		
	IEC 61131-2	**B&R Limit Value**
Power supply	2 kV, 1 min	4 kV, 5 min
All other lines	1 kV, 1 min	2 kV, 5 min

IEC 61000-4-5 Surge		
	Limits CM, unsymmetrical	**Limits DM, symmetrical**
AC power supply	2 kV (12 Ω)	1 kV (2 Ω)
DC power supply	1 kV (12 Ω)	0.5 kV (2 Ω)
Digital and analog I/O, AC, unshielded AC auxiliary voltage outputs for sensors, etc.	2 kV (42 Ω)	1 kV (42 Ω)
Digital and analog I/O, DC, unshielded Data lines, unshielded DC auxiliary voltage outputs for sensors, etc.	0.5 kV (42 Ω)	0.5 kV (42 Ω)
All shielded lines	1 kV (2 Ω)	---

IEC 61000-4-6 Conducted Disturbances (radio frequency)	
Network connections Signals >10 m Functional ground	150 kHz – 80 MHz, 10 V, (in broadcast range 3 V) 80 % amplitude modulation with 1 kHz

IEC 60664-1 Pollution Degree
Pollution degree 2: non-conductive pollution

IEC 60068-2-6, Test Fc Vibration Test		
Frequency Range [Hz]	**Continuous**	**Periodic**
$10 \leq f < 57$	0.0375 mm amplitude	0.075 mm Amplitude
$57 \leq f \leq 150$	0.5 g constant acceleration	1 g constant acceleration
$f > 150$	not defined	not defined

IEC 60068-2-27, Test Ea Shock Test
Periodic peaks up to 15 g over 11 msec, half sine wave in all three perpendicular axes.

1.3 INTERNATIONAL STANDARDS

B&R products and services meet all required standards. These are international standards from organizations such as ISO, IEC and CENELEC, as well as national standards of organizations such as UL, CSA, FCC, VDE, ÖVE, etc. We give special consideration to the reliability of our products in an industrial environment. For example, the requirements of the product standard IEC 61131-2 for electromagnetic immunity are exceeded considerably.

Certifications	
USA and Canada	All important B&R products are tested and listed by Underwriters Laboratories and are checked quarterly by a UL inspector. This mark is valid for the USA and Canada and eases certification of your machines and systems in these areas.
Europe	All harmonized IEC standards for the valid guidelines are met.
Russian Federation	B&R has a GOST certification for all products for export to the Russian Federation.

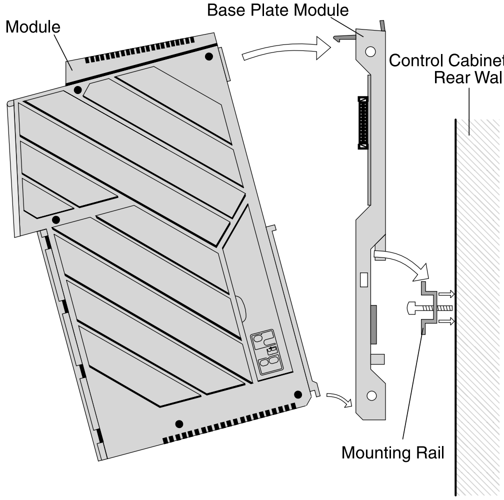
2 B&R 2010 CONTROL SYSTEM

2.1 MODULAR CONSTRUCTION

The B&R 2010 Control System consists of single plastic encapsulated modules which are attached to the base plate (also of modular construction).

There are two methods of attaching the base plate:

The base plate can be hung on a mounting rail (IEC 50 022 - 35 x 7.5 mm). The mounting rail must be conductively connected to the control cabinet back wall.
The base plate can be screwed directly to the rear wall of the control cabinet.

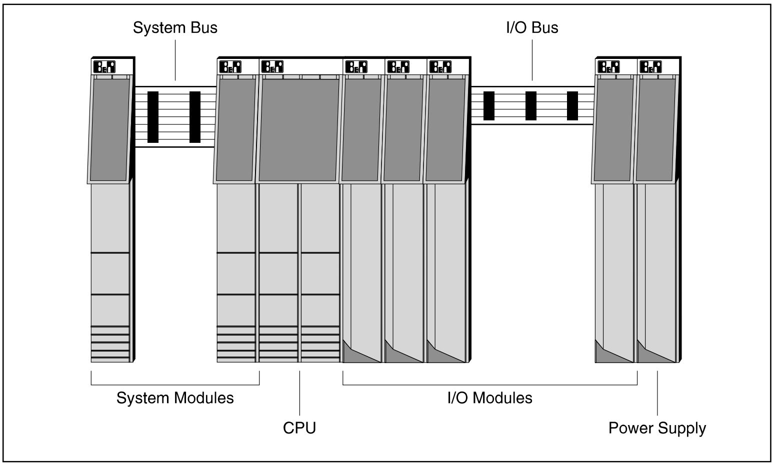


2.2 SEPARATED SYSTEM AND I/O BUS

One prominent feature of the B&R 2010 control system is the separation of the **System and I/O Bus**. I/O and power supply modules are situated on the I/O bus and system modules plug into the system bus (e.g. network modules, multiprocessors).
The use of separate bus systems provides the following advantages:

- ❍ Higher data throughput, since the system and I/O buses do not affect each other:
  - The I/O-bus has a constant, deterministic and cyclic data responsibility for managing classic PCC modules (e.g. digital or analog input/output modules).
  - High volumes of data appear sporadically on the system bus, however due to the separate bus systems, the data stream on the I/O-bus is not disturbed.
- ❍ Secure I/O data transfer

The CPU is the interface between the system and I/O bus:



B&R 2010 Bus System

2.3 POWER SUPPLY

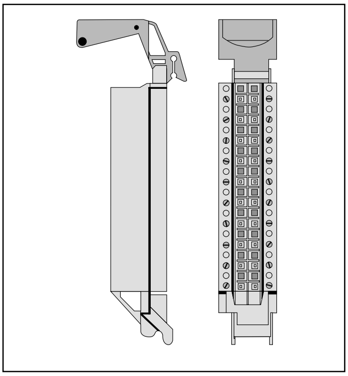
In the B&R 2010 control system, a decentralized power supply has been implemented. Any number of power supply modules can be connected on the I/O bus. The I/O and system modules are supplied via the bus system.

It is possible to set up a redundant voltage supply by using more power supply modules than necessary. This way voltage supply to the PCC is guaranteed, even if a power supply module fails.

2.4 DOUBLE ROW TERMINAL BLOCK

Modules in the B&R 2010 control family are connected by means of a quick-lock terminal block.

The pin assignments for each module are found in this manual (chapter "B&R 2010 Modules"). This terminal block construction provides the following advantages:



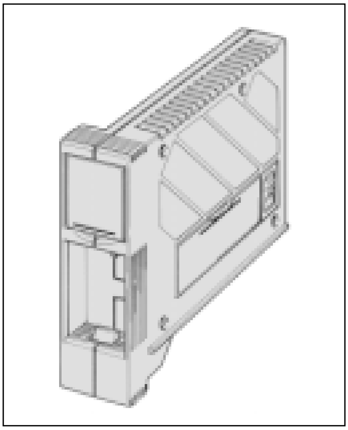
B&R 2010 Terminal Block

- A status LED on every I/O module indicates if the terminal block is correctly inserted. This information can also be accessed by an application program.
- The terminal block is coded, which prevents insertion into an incorrect I/O module.
- The terminal block is easily removed using a built-in ejection lever.

2.5 APPLICATION MEMORY (APM)

All software required for the B&R 2010 PCC system to function (operating system, application program) is stored in the application memory. This application memory is inserted in the front of the processor module.

An overview of the available APM variations is found in chapter "B&R 2010 Modules" in this manual.



B&R 2010 Application Memory

3 B&R 2010 EXPANSION

3.1 DIVISION OF THE LOCAL I/O BUS

On a single I/O bus, a maximum of 99 modules can be addressed (I/O modules, power supply modules, expansion modules). This I/O bus can be separated into many **Bus Segments** (max. 10) using expansion modules. For this type of I/O bus expansion, the following modules are required:

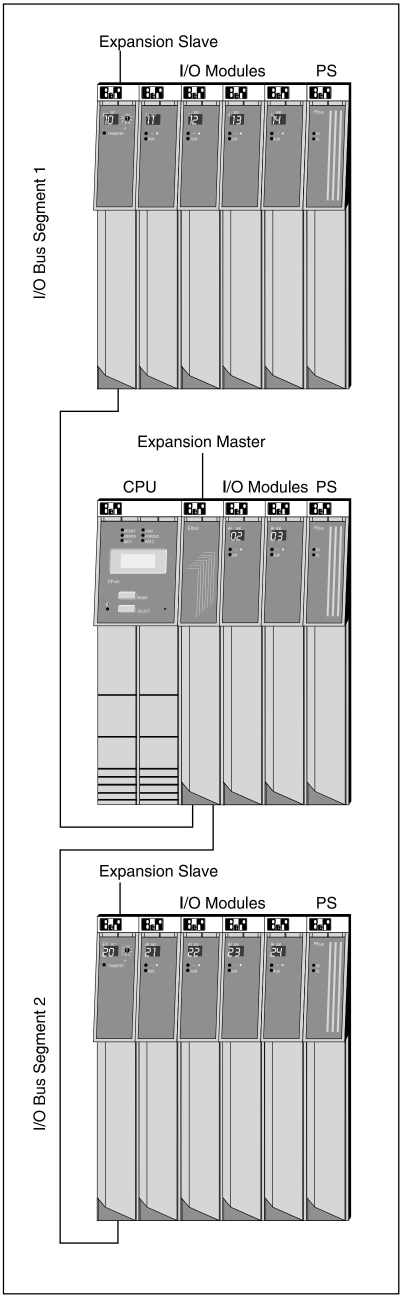
3.1.1 Expansion Master

Two I/O bus segments can be operated with each expansion master. Expansion masters can be installed on any bus segment.

3.1.2 Expansion Slave

This module communicates with the expansion master and must be installed in the first slot.

The cable connecting expansion master to the slave is available in 2 lengths (1m or 2m).



B&R 2010 I/O Bus Expansion

Dividing the bus provides the following advantages:

- Placement of I/O modules is not limited by the size and shape of control cabinet or mounting wall.
- Utilization of all slots for I/O modules is always possible, regardless of the amount of space available (excluding slots for expansion master, expansion slave and power supply modules).

3.2 REMOTE I/O BUS

Distant I/O modules (up to 1200 m) can be connected to the central processing unit using remote I/O. To construct a remote I/O system, the following modules are required:

3.2.1.Remote Master Module

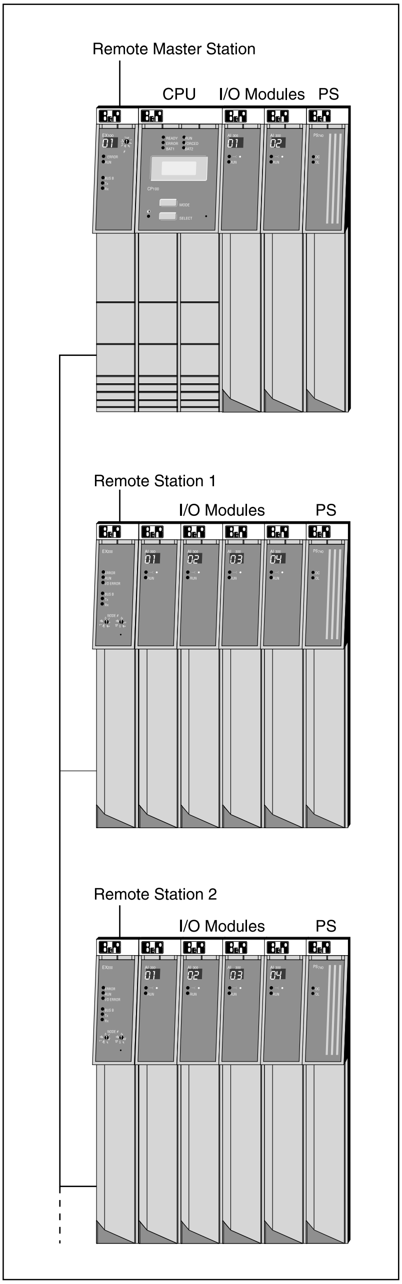
The remote master is a system module and must be placed on the system bus. A remote master module can support up to 31 remote slave modules.

3.2.2 Remote Slave Module

The remote slave module communicates with the remote master module via a shielded, twisted pair cable. The remote slave module must be placed in the first slot of the I/O bus. Every remote slave module begins an I/O bus which can address up to 99 modules. Using expansion master and slave modules, a remote I/O bus can also be divided into bus segments.

Cabling: A remote I/O system allows I/O buses to be placed up to 1200 m from the central processing unit. These are connected with a shielded, twisted pair cable.

Transmission Distances (without repeater)	
100 kBit/sec	up to 1200 m
181 kBit/sec	up to 1000 m
500 kBit/sec	up to 400 m
1000 kBit/sec	up to 200 m
2000 kBit/sec	up to 100 m



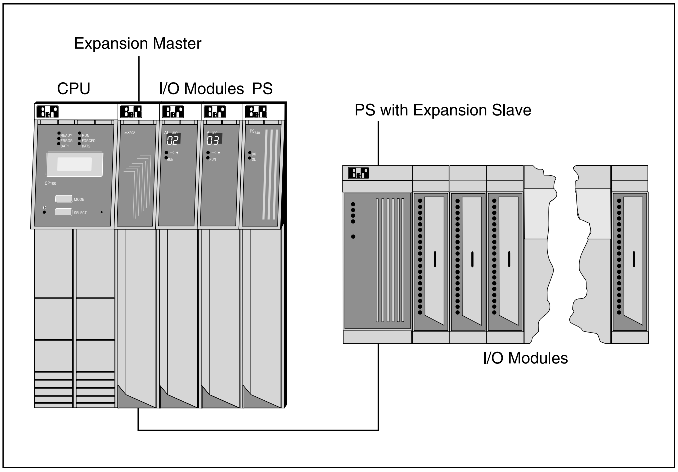
B&R 2010 Remote I/O

4 POSSIBLE COMBINATIONS

4.1 LOCAL I/O BUS

4.1.1 Coupling a B&R 2005 to a B&R 2010

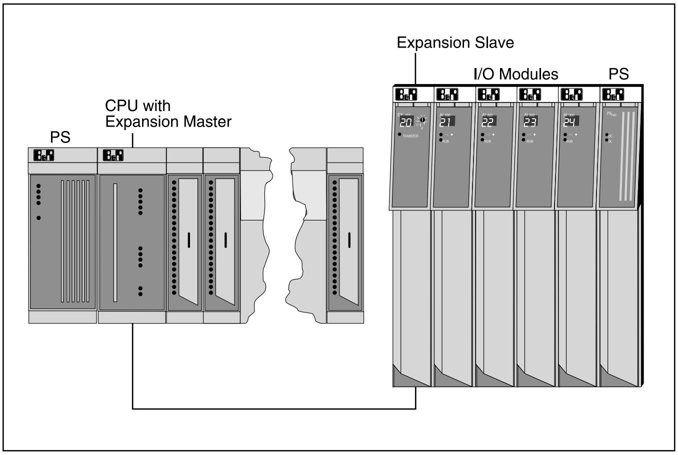
A 2005 expansion rack is linked to a 2010 expansion master via a power supply with expansion slave. The entire configuration may include a maximum of four 2005 expansion racks.



Connecting a 2005 to a 2010

4.1.2 Coupling a B&R 2010 to a B&R 2005

A 2010 I/O bus is linked to the 2005 CPU (with expansion master) via an expansion slave. The amount of 2010 I/O modules which can be connected in this way is limited to 20.



Connecting a 2010 to a 2005

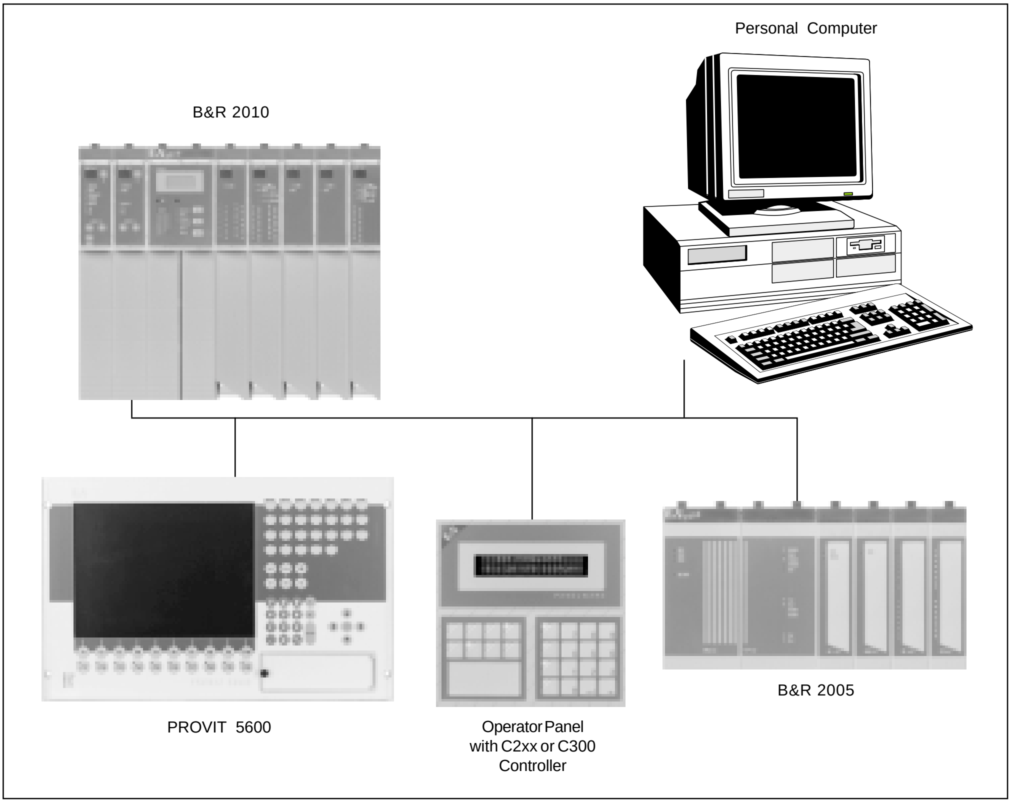
4.2 REMOTE I/O BUS

4.2.1 Connecting a B&R 2005 and a B&R 2010

Up to 31 remote slaves can be connected to a remote master (2010 or 2005). The B&R 2003, 2005 and 2010 can be mixed as required. A new I/O bus is started with every remote slave. The maximum amount of slot positions depends on the slave type present.

Slave Type	Number of Slots
2010	max. 99
2005	max. 13
2003	max. 8

5 PROFIBUS NETWORK



PROFIBUS Network

"PROFIBUS" has been chosen as the networking standard for the B&R 2000 control generation.

PROFIBUS (Process Field Bus) is an open field bus with standard communication functions.

Transmission Distances (without repeater)	
19.2 kBit/sec.	up to 1200 m
93.75 kBit/sec.	up to 1200 m
187.5 kBit/sec.	up to 1000 m
500 kBit/sec.	up to 400 m

CHAPTER 2

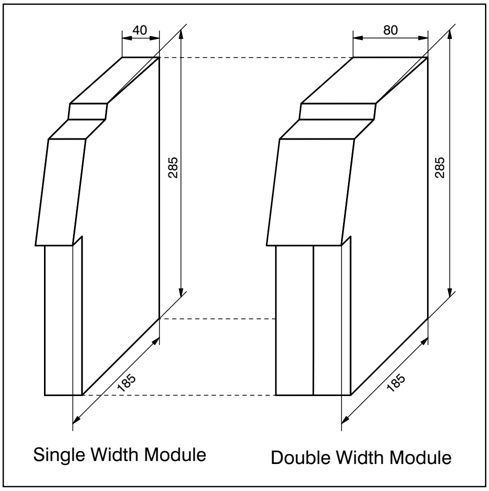
PROJECT PLANNING AND INSTALLATION

1 DIMENSIONS AND INSTALLATION

1.1 PCC MODULES

The B&R 2010 system consists of single and double width modules. The width corresponds to the number of positions (slots) the module requires on the bus:

Width	Bus Positions
Single width	1
Double width	2



The measurements shown in the figure on the right do not include the base plate depth. When calculating the total depth of the PCC, the base plate dimensions must also be taken into account (all measurements in this manual are rounded off to the nearest millimeter).

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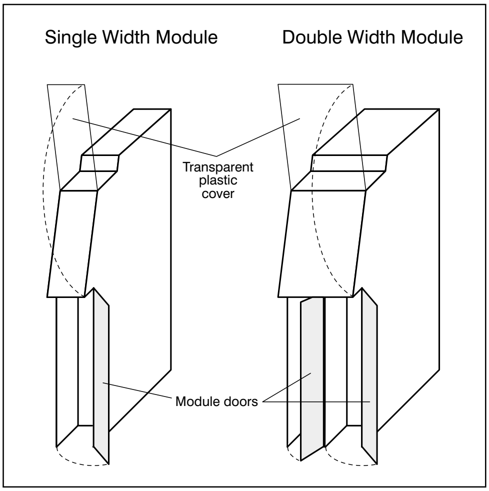
Project Planning
and Installation

1.2 BASIC MODULE STRUCTURE

Every module front is split into two areas:

- ❍ Status display
- ❍ Connection area



The **status display** is located under a clear plastic cover which can be opened. Depending on the module, this area contains indication or operational elements such as e.g. seven segment displays, status LEDs, number switches, reset button, etc. In addition to dust and environmental protection the plastic cover is also for improved ESD immunity and should always be closed while the PCC is in operation.

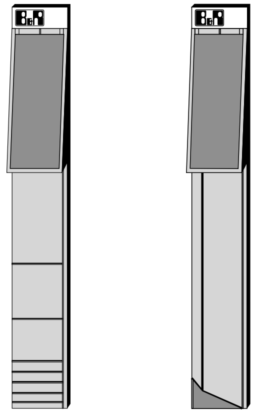
The **connection area** is situated behind the module door. Behind this door you will find the D-type connectors and terminal block pin sockets. Two doors are found on processor modules which are double width. Application memory module is inserted behind the second door.

A label with a short description documenting interfaces and connections can be inserted on the inside of I/O and CPU module doors.

1.3 SYSTEM AND I/O MODULES

The difference between system and I/O Modules can be seen in the B&R 2010 system. The bottom edge of the module door is straight on a system module and sloped on an I/O module.

This makes is easier to perform a visual safety check. Only I/O modules with sloped doors are allowed to the right of the CPU module and only system modules with straight bottomed doors are allowed on the left of the CPU module.



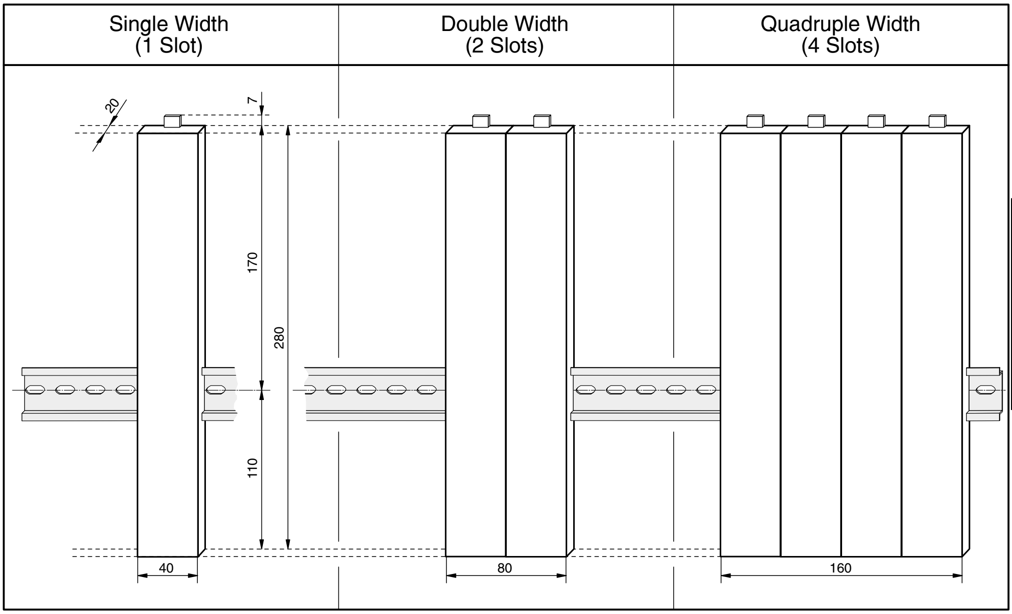
1.4 BASE PLATE MODULES

The base plate on which the system or the I/O bus is situated is also of modular construction. The base plate modules are available in various widths and are divided into three basic groups:

Base plate modules for system bus	Base plate modules for CPUs	Base plate modules for I/O bus	
BP101		BP200 BP201	Base plate modules without bus termination
BP110	BP300	BP210	Base plate modules with bus termination
		BP202	Base plate module for bus expansion (expansion slave) or remote I/O (remote slave)

System bus — Connection for system bus — I/O bus — Connection for I/O bus

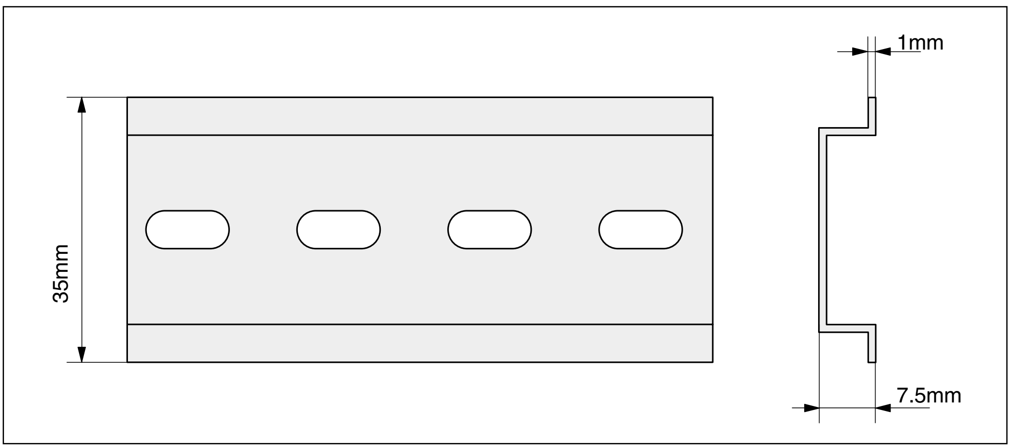
Base Plate Modules:



1.5 MOUNTING RAIL

A mounting rail which conforms to the standard DIN IEC 50022 must be used to mount the PCC. This mounting rail must be fixed to the control cabinet wall and properly grounded.

Follow the manufacturer's instructions to ensure a proper installation!



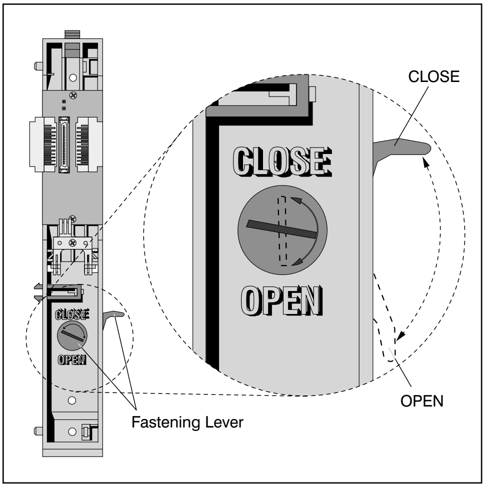
Mounting Rail IEC 50022 - 35 x 7.5

1.6 MOUNTING AND INSTALLATION

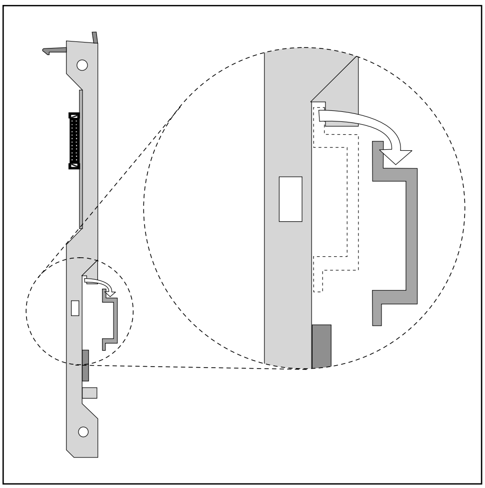
Mounting the system should only be done by experienced personnel!

Mounting the PCC system must be done in a specific order:

1) Install the mounting rail (see section "Grounding the Mounting Rail")
2) Mount the Base Plate
3) Mount the PCC Module



OPEN or CLOSE Position of the Fastening Lever



Hang Base Plate Module on the Mounting Rail

Mounting the Base Plate

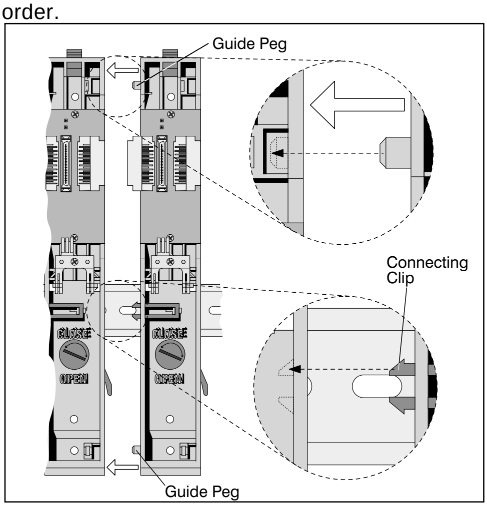
In order to put the different base plate modules together on the mounting rail, the following steps must be followed:

a) Put all fastening levers in the "**OPEN**" position.
b) Hang the outermost base plate module in the desired position.
c) Hang the other base plate modules on the mounting rail pushing them to the left until the connecting clip engages. The guide peg must be aligned with the hole in the module to its immediate left.
d) After all base plate modules have been hung and connected together, all fastening levers should be moved to the "**CLOSE**".

Both the system and the I/O buses must be ended with a base plate module that has a bus termination (exception: 2 slot system bus).

The base plate modules should be arranged so that the single width modules are situated at the end of the bus and the quadruple width modules on the base plate module where the CPU module is inserted. This will save time for future expansion.

Removing the base plate is done in the reverse order.

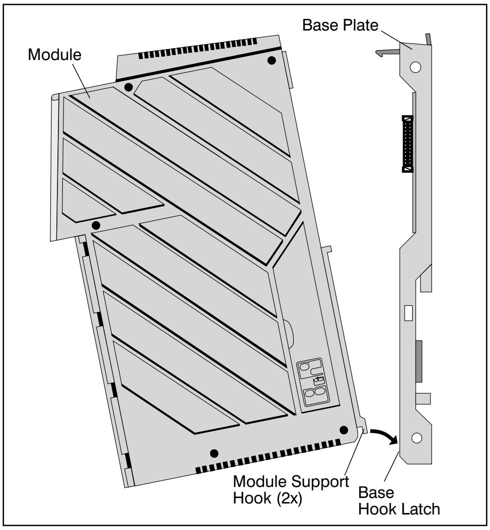


Connecting Base Plate Modules

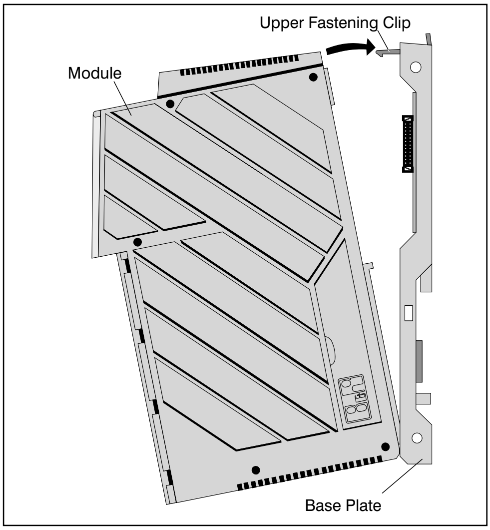
Mounting PCC Modules

After the base plate is fastened securely to the mounting rail, the PCC module can be mounted in the appropriate base plate slot. A module is installed in the following manner:

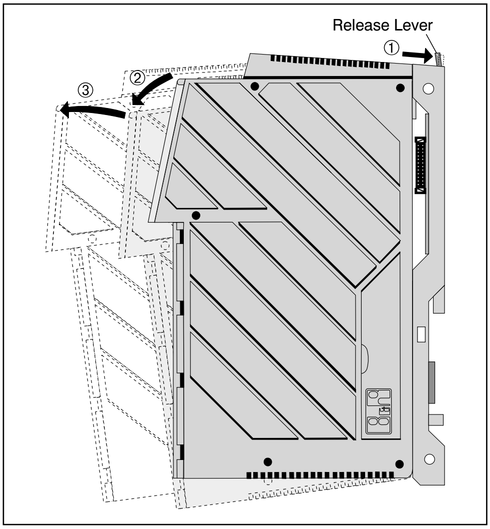
a) Hang the module with the module support hook on the base hook latch of the base plate:



b) Tilt the module back until the upper fastening clip of the base plate clicks into place:



To **remove** the PCC module, follow the same directions in the reverse order. Pressing the release lever (①) will unclip the attachment. The module can be tipped forward (②) and taken out of the base plate (③).



Chaptetr 2
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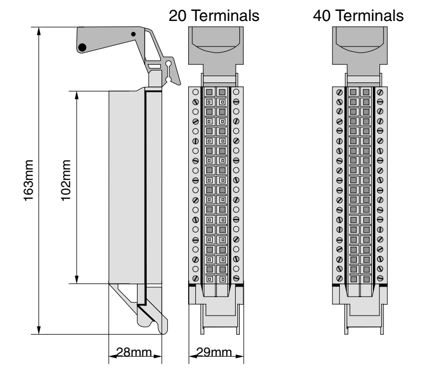
1.7 DOUBLE ROW TERMINAL BLOCK

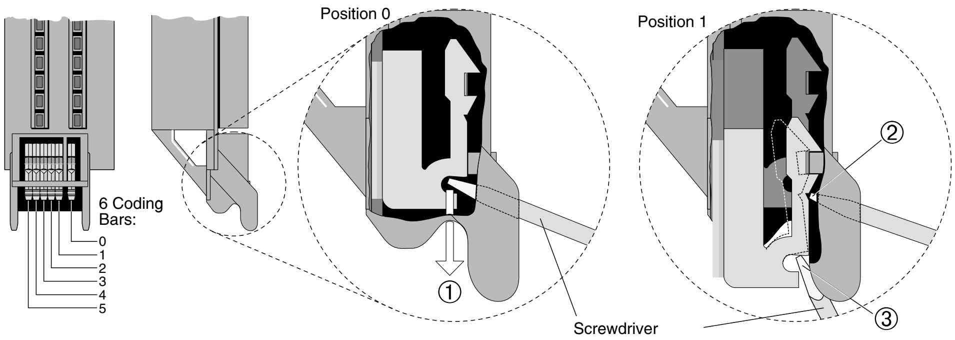
Connections are made on the module using a double row terminal block which can be easily plugged and unplugged. By using coding bars on the terminal block and on the module casing, a clear relationship between a terminal block ↔ module or slot is established. A proper connection of the terminal block is monitored and indicated by a status LED.



Terminal Block Coding

Terminal block coding ensures that the terminal block cannot be inserted into the wrong module (locked). A terminal block which is specifically for connection to a digital output module can be coded so that it will not be accepted in any input module for example. This coding is done with 6 coding bars on the terminal block and on the pin block of the module.

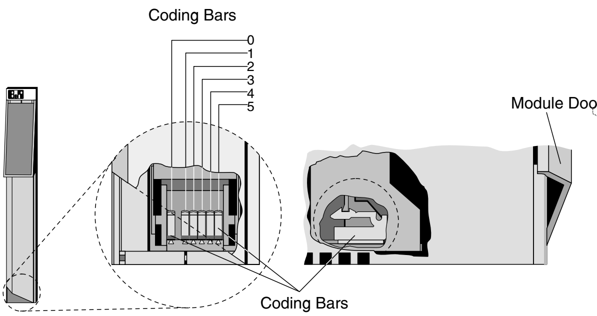
How to Code the Terminal Block:

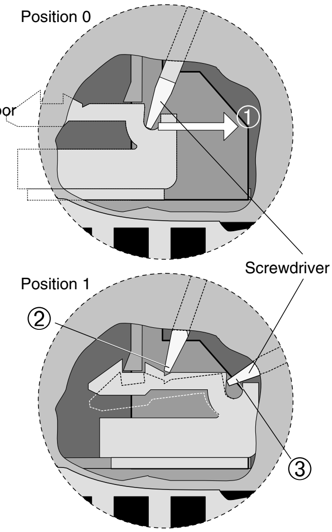


a) In order to change the coding bar from position 0 to position 1, use a screwdriver to move the bar in direction ① in the figure above until the bar locks into place.

b) To move the coding bar from position 1 to position 0, pressure must be applied to two points on the clip. Press a screwdriver into the small notch ② through the front of the casing to unlatch the locking clip and then push the clip upwards as far as possible. Using the screwdriver, apply pressure at the base of the coding bar ③ and it will slide into the casing again.

Module Coding:





a) To move a coding bar from position 0 to position 1, apply pressure using the screwdriver in the direction shown at ① (towards the front) until the bar clicks into position.

b) In order to move a coding bar from position 1 to position 0, press a screwdriver tip into the small notch ② in the coding bar to unlatch the locking clip and move the bar upwards as far as possible. Use the screwdriver again to press against the base of the coding bar ③ and move the bar sliding back into the casing until it is in position 0.

The terminal block cannot be inserted if a coding bar on the terminal block and the respective coding bar on the module are both in position 1:

Coding bar		Insertion of
Terminal Block	**Module**	**Terminal Block**
0	0	Possible
0	1	Possible
1	0	Possible
1	1	NOT Possible

Modules and terminal blocks are delivered from B&R with certain factory code settings:

	Positions of all coding bars upon delivery
Terminal block	0
Module	1

Coding Criteria:

Coding terminal blocks is done to ensure that damage to PCC modules, external input or output circuits is avoided. This means:

- ❍ Input and output terminal blocks may not be exchanged.
- ❍ Terminal blocks on modules having different voltage ratings may not be exchanged.

Inserting the Terminal Block

The double row terminal block is inserted into the pin block of the module. Follow the steps below for inserting the terminal block:

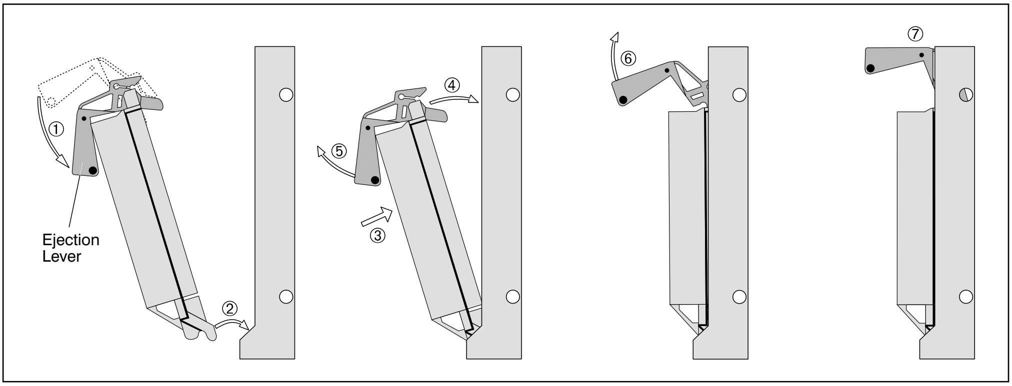
a) Before insertion, the ejection lever must be pressed all the way down (①).

b) Hook the terminal block on the bottom edge (②).

c) Press the terminal block forward (③) until it is firmly up against the pin block (④). This will automatically move the ejection lever upwards (⑤).

d) Lift the ejection lever up to lock the terminal block into place (⑥).

e) Ejection lever is in the locked position (⑦).



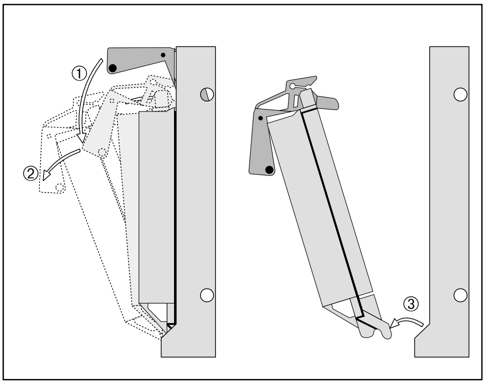
Removing the Terminal Block

The steps below are taken to remove the terminal block:

a) Press the ejection lever down (①).

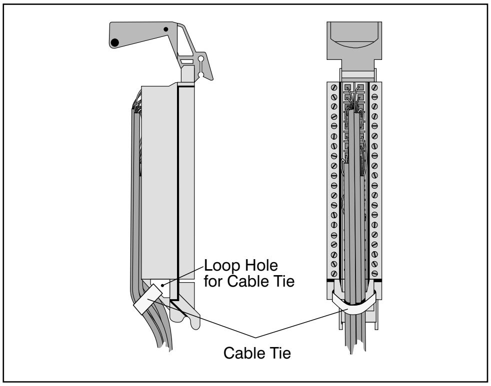
b) Pull the ejection lever away from the module (②).

c) Unhook the terminal block from the casing (③).



Terminal Block Cable Guide

All cables (cable bunch) are run from the respective terminals to the bottom of the terminal block. A cable tie is used for stress relief. All of the cable for this terminal block are run through it.



2 SYSTEM CONFIGURATION AND POWER SUPPLY

2.1 SYSTEM B&R 2010

The following guidelines should be adhered to for every configuration:

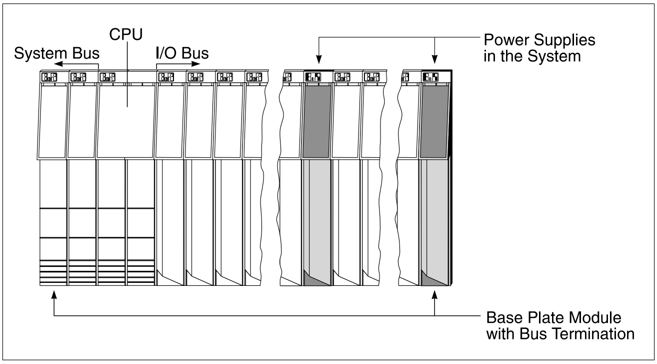
- System modules may only be located to the left of the CPU and I/O modules only to the right.
- System modules must always be connected directly to the CPU. No slots may remain vacant between system modules.
- The system and I/O bus must be ended with a base plate module having a bus termination (with the exception of a system bus with two slots).
- Empty slots must be filled with dummy modules.
- A maximum of 20 I/O modules may be installed on one bus segment.

Different sources can be used to feed power supplies.

2.1.1 Local Bus without Expansion

Main Components:

The amount of power supplied for the B&R 2010 system is based on the amount of modules used and whether one or more power supplies is needed. Positioning these power supplies should be done according to the diagram on the right:



1) B&R recommends putting a power supply in the right-most slot of the I/O bus.

2) The slot positions for the other power supplies are determined by means of a simple rule:

   The power consumption of the modules is added from the right-hand side to the left. The sum is not allowed to reach zero, otherwise another power supply must be added (this can be seen in the example on the next page). An exception to this rule is the left-most slot since on system buses no power supply can be inserted.

   A module overview can be found at the beginning of the chapter "B&R 2010 Modules". This chapter details the modules technical and performance characteristics. This enables a power requirement equation to be calculated quickly and precisely for a particular hardware configuration.
   A power supply should not be situated directly next to a module with high power consumption because the power supply module becomes very warm.

Example to clarify the positioning of power supply modules:

- The following modules are required in the system:

Amount	Module		Bus	Consumption [W]	Per Module Σ
1	NW100	Network Module	System bus	15	15
1	CP100	CPU	System or I/O Bus	15	10
1	AI300	Analog Input Module	I/O Bus	9	9
4	AT610	Temperature Module	I/O Bus	8	32
3	AO300	Analog Output Module	I/O Bus	10	30
2	DI426	Digital Input Module	I/O Bus	6	12
2	DO700	Digital Output Module	I/O Bus	6	12
				Σ =	120

- 100 W power supplies should be used. Please take into consideration that the output power of the power supply depends on the ambient temperature and input voltage (see Technical Data).

Module	Power [W] 1)	Σ [W]	Notes
PS	**+100**	**+100**	B&R Recommendation: Power supply in the right-most slot of the I/O Bus
DO700	-6	+94	
DO700	-6	+88	
DI426	-6	+82	
DI426	-6	+76	
AO300	-10	+66	
AO300	-10	+56	
AO300	-10	+46	
AT610	-10	+36	
AT610	-10	+26	
AT610	-10	+16	
AT610	-10	+6	
AI300	-9	+5	
PS	**+100**	**+105**	Another power supply must be put in here, because there is not enough power (6W) to supply another module.
CP100	-15	+95	
NW100	-15	+80	There are 80 W still left over besides what is required by the modules (Reserve).

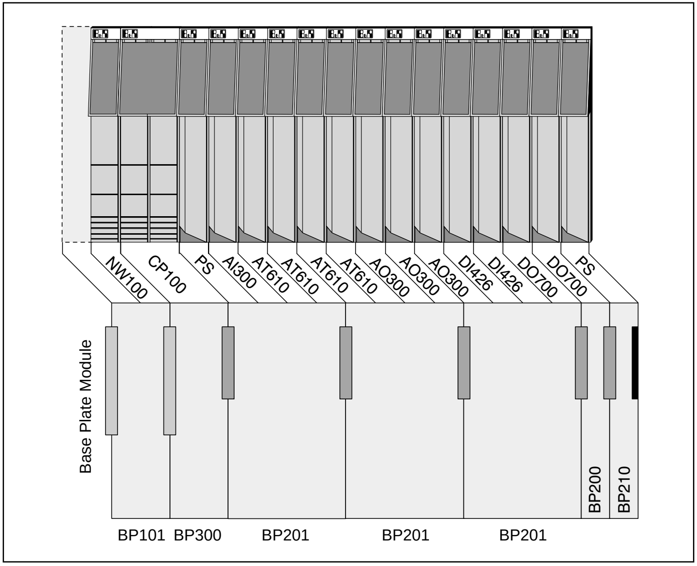
1) The power consumption of a module is indicated with a "-" and the power supplied by the power supply with a "+".

The diagram to the right shows a system based on the example chart on the previous page.

If the modules need to be positioned in a different sequence, the calculations must be redone.

After the required amount of power supplies for the system has been determined, the base plate modules can be selected (see section "Base Plate Modules").

All empty slots must be filled with dummy modules.



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Project Planning and Installation

2.1.2 Local Bus with Expansion

Using expansion modules **Expansion Master** and **Expansion Slave**, the I/O Bus can be split up into a maximum of 10 bus segments.

Please note the following:

❍ An expansion master can be operated in any slot on every bus segment of the I/O bus.

❍ The expansion slave is always placed in the left-most slot of a bus segment.

❍ The base plate module BP 202 is required for the expansion slave alone.

❍ B&R recommends that a power supply be positioned in the right-most slot of the bus segment.

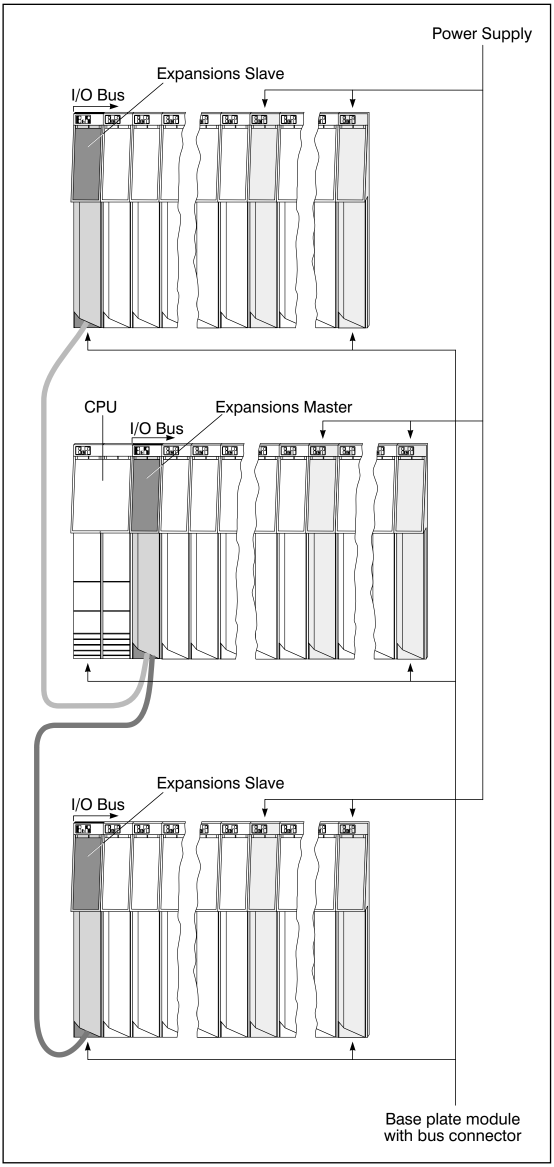
❍ The module address is to be set on the expansion slave with the node number switch. This is actually the number of the slave expansion module which determines the numbers for all I/O modules under it on its own base plate. These settings are made in steps of ten (10, 20, ... 90), whereas no address can be used twice.

❍ Cables are available from B&R for connecting expansion master and slaves:

Length	Model Number
1 m 2 m	0G0010.00-090 0G0012.00-090

❍ A maximum of 20 I/O modules are allowed per bus segment.

❍ Positioning the power supply is done according to the same plan as described in section "Local Bus without Expansion" for every bus segment.



The following example should clarify the configuration of a local bus with expansion:

❍ The system (see Example "Local Bus without Expansion") should be expanded with two bus segments, i.e. the I/O Bus will be continued on a different base plate.

❍ In order to keep the cables to the expansions as short as possible the Expansion Master EX302 is located directly next to the CPU. This means that the calculations for required power supplies must also be redone:

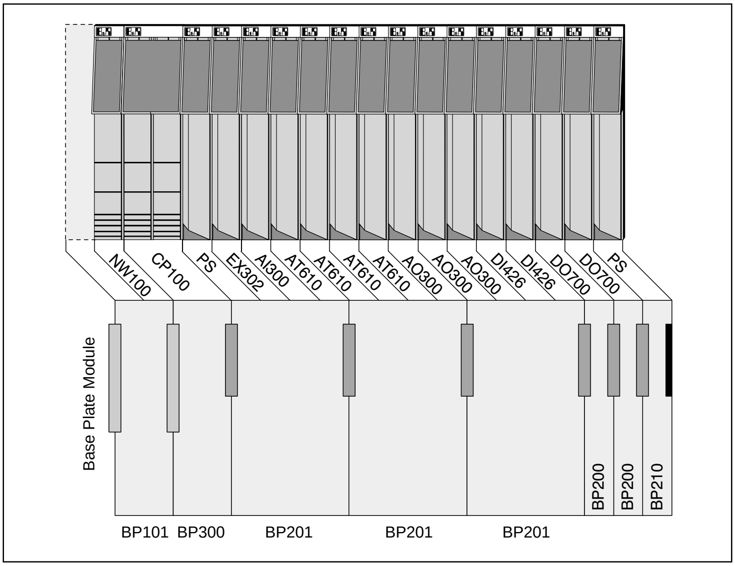
Module	Power [W] [1]	Σ [W]	Notes
PS	**+100**	**+100**	B&R recommendation: Power supply in the right-most slot of the I/O Bus
DO700	-6	+94	
DO700	-6	+88	
DI426	-6	+82	
DI426	-6	+76	
AO300	-10	+66	
AO300	-10	+56	
AO300	-10	+46	
AT610	-8	+38	
AT610	-8	+30	
AT610	-8	+22	
AT610	-8	+14	
AI300	-9	+5	
EX302	-3	+2	
PS	**+100**	**+102**	A second power supply must be positioned here because the first doesn't supply enough power (2 W) for the next modules.
CP100	-10	+92	
NW100	-15	+77	There are still 77 W available. The modules do not require all that the power supply offers (This reserve power cannot be used for an another expansion base plate).

[1] The power consumption of a module is indicated with a "-" and the power supplied by the power supply with a "+".

After the calculations have been made, the layout can be set up according to the diagram on the right.

After the required amount of power supplies has been determined for the system, the base plate modules can be selected (see section "Base Plate Modules").

All empty slots must be filled with dummy modules.



❍ Expansion 1 should contain the following modules:

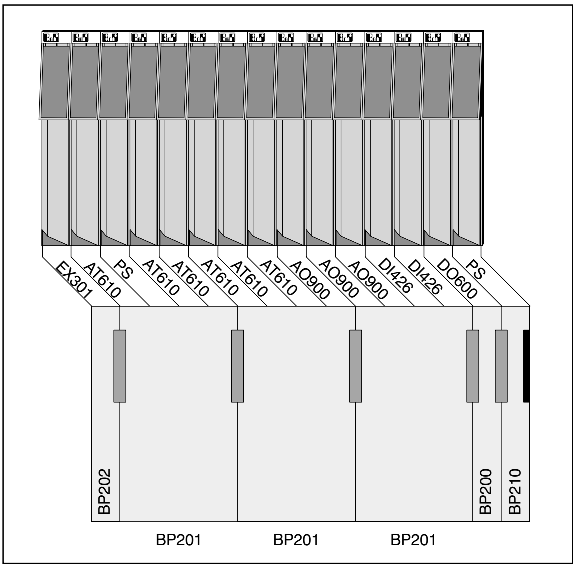
Amount	Module		Bus	Power Consumption [W] per Module	Σ
1	EX301	Expansion Slave	I/O Bus	3	3
6	AT610	Temperature Module	I/O Bus	8	48
3	AO900	Analog Output Module	I/O Bus	10	36
2	DI426	Digital Input Module	I/O Bus	6	12
1	DO600	Digital Output Module	I/O Bus	8	8
				Σ =	107

❍ 100 W power supplies should be used.

Module	Power [W] [1)]	Σ [W]	Notes
PS	**+100**	**+100**	B&R recommendation: Power supply in the right-most slot of the I/O Bus
DO600	-8	+92	
DI426	-6	+86	
DI426	-6	+80	
AO900	-12	+68	
AO900	-12	+56	
AO900	-12	+44	
AT610	-8	+36	
AT610	-8	+28	
AT610	-8	+20	
AT610	-8	+12	
AT610	-8	+4	
PS	**+100**	**+104**	A second power supply must be positioned here because the first doesn't supply enough power (2 W) for the next modules.
AT600	-8	+96	
EX301	-3	+93	The Expansion Slave must be situated in the left-most slot. There are 89 W still left over besides what is required by the modules (Reserve).

1) The power consumption of a module is indicated with a "-" and the power supplied by the power supply with a "+".

Sequence of the modules and the required base plate modules:



- Expansion 2 should contain the following modules:

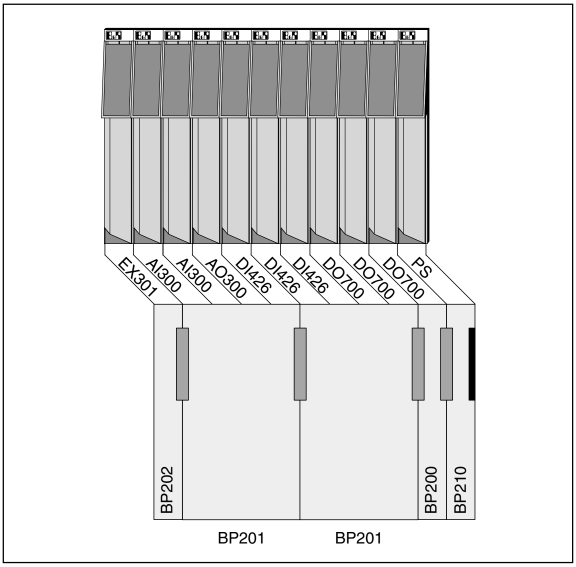
Amount	Module		Bus	Power Consumption [W] per Module	Σ
1	EX301	Expansion Slave	I/O Bus	3	3
2	AI300	Analog Input Module	I/O Bus	9	18
1	AO300	Analog Output Module	I/O Bus	10	10
3	DI426	Digital Input Module	I/O Bus	6	18
3	DO700	Digital Output Module	I/O Bus	6	18
				Σ =	67

- 100 W power supplies should be used.

Module	power [W] [1)]	Σ [W]	Notes
PS	**+100**	**+100**	B&R recommendation: Power supply in the right-most slot of the I/O Bus
DO700	-6	+94	
DO700	-6	+88	
DO700	-6	+82	
DI426	-6	+76	
DI426	-6	+70	
DI426	-6	+64	
AO300	-10	+54	
AI300	-9	+45	
AI300	-9	+36	
EX301	-3	+33	The Expansion Slave must be situated in the left-most slot. There are 33 W still left over besides what is required by the modules (Reserve).

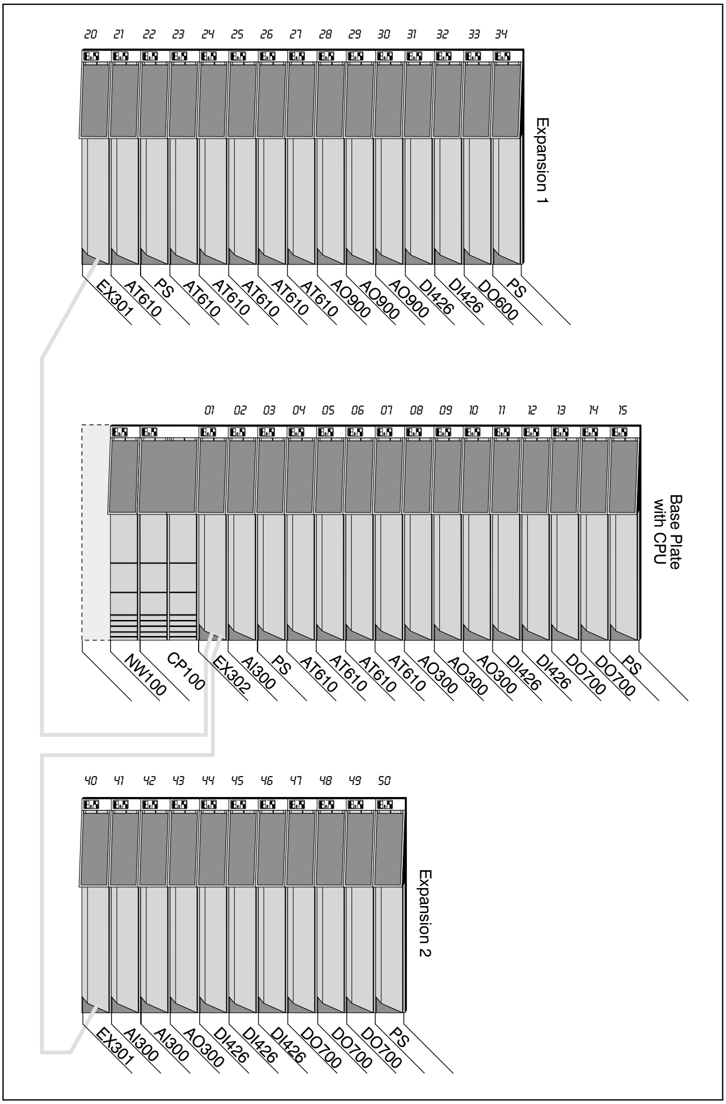
[1)] The power consumption of a module is indicated with a "-" and the power supplied by the power supply with a "+".

Sequence of the modules and the required base plate modules:



The Expansion Slaves are connected to the Expansion Master. Node number switches are used to set the module address from which the counting starts for addressing the bus segment. In order to achieve the addressing shown in the diagram to the right, the node number switches of the expansion slaves must be set as follows:

Expansion Slave	Address to be set
Expansion 1	20
Expansion 2	40

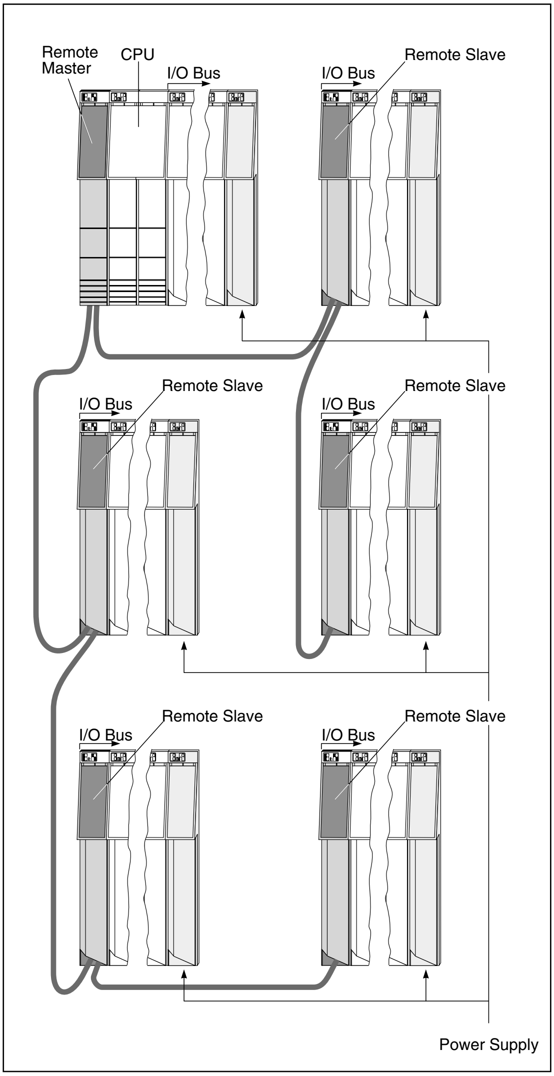


2.1.3 Remote I/O Bus

Remote I/O means connecting I/O modules to the CPU over a long distance. A bus cable connects one **Remote Master Module** and the **Remote Slave Modules** (two chains connecting a total of up to 31 remote slaves can be run from the remote master) An I/O bus which can address up to 99 modules begins with every slave module. Every I/O bus can also be split into bus segments (see “Local Bus with Expansion”).

The maximum extension of the remote system depends on the transmission rate:

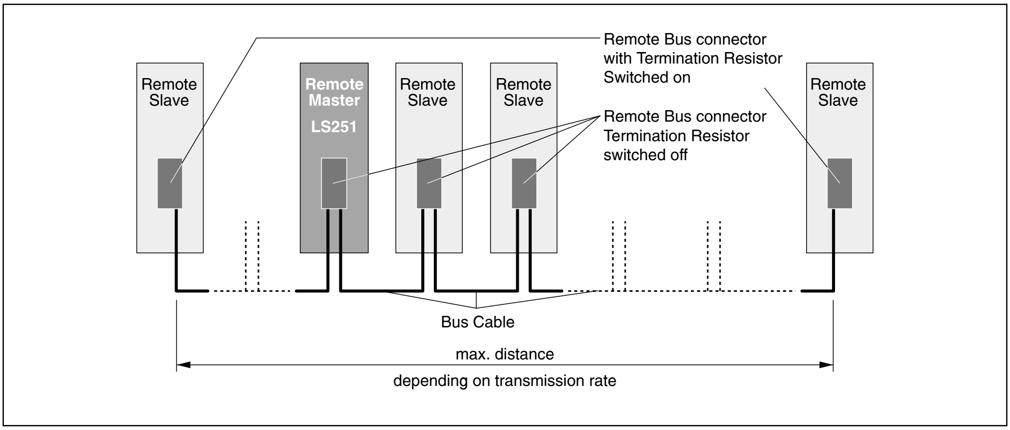
Max. distance	Transmission rate [kBit/sec]
1200m	100
1000m	181
400m	500
200m	1000
100m	2000



Note the following:

- ❍ The Remote Master is a system module and therefore must be situated left of the CPU on the system bus. The module address is set with the node number switch.
- ❍ The Remote Slave is always situated in the outermost left-hand slot on the I/O bus.
- ❍ The Remote Slave requires the base plate module BP202.
- ❍ The slave address (1 to 98) which the Remote I/O bus is to be addressed with must be set on the remote slave.
  By setting 99 on the number switch, dynamic addressing can be used (see technical data in chapter "B&R 2010 Modules")
- ❍ B&R recommends the a power supply be situated in the right-most slot of the I/O bus.
- ❍ Positions for power supply modules are the same as is described in section "Local Bus without Expansion".
- ❍ Two RS485 interfaces are available on every remote module in the B&R 2010 system. The second interface is planned for "Redundant Operation". In this mode of operation, the remote bus is connected with two cables. If an interface error occurs, the data is transferred via the "Redundant Interface" and onto the bus as normal.

Connecting Remote Master and Slave Modules



Bus Cable (according to DIN 19245 part 3)

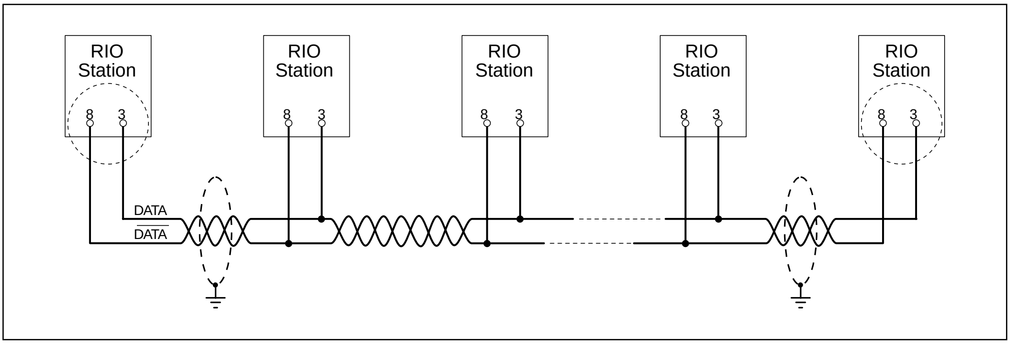
The connection from the remote master and slave modules is made with twisted pair cables which must conform to the following specifications:

Characteristic Impedance	135 - 165 Ω (3 - 20 MHz)
Capacitance per unit length	< 30 pF / m
Loop resistance	< 110 Ω / km
Wire diameter	> 0.64 mm
Wire CSA	> 0.34 mm^2

The twisted pair cable must be terminated on both ends with the individual stations as follows:

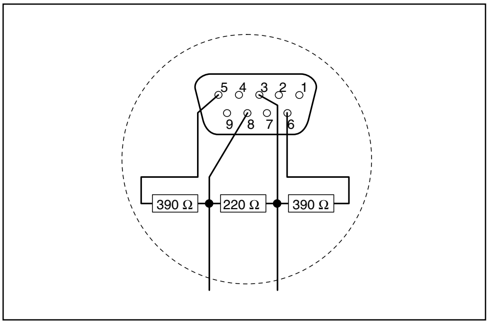
Bus cable ↔ Station connection

The two wires of the bus cable are connected with the individual stations as follows:



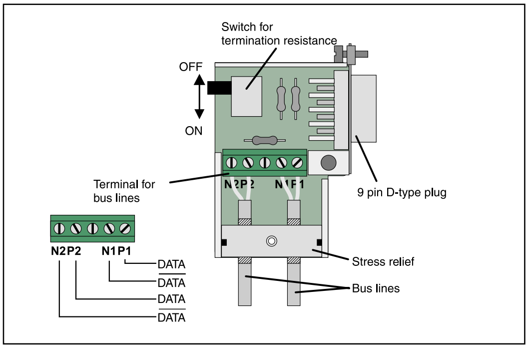
Termination Resistors

The remote bus is to be terminated on both ends with a termination resistor (see also chapter "B&R 2010 Modules" in section "Remote Modules").
Termination resistors are intergrated in all B&R remote bus connectors 0G1000.00-090. The termination resistors can be turned on or off.



Remote Bus Connector:

Model Number: 0G1000.00-090



2.1.4 PROFIBUS

.
Remote I/O bus connection (bus cable, termination resistors) are also used for PROFIBUS. The B&R PROFIBUS network modules available are the NW150 for B&R system 2005 and NW100 for the B&R 2010 system.

2.1.5 RS485 Network

The cable listed for the remote I/O bus (bus cable, termination resistance) is also used for an RS485 network.

2.2 CONFIGURING A MIXED SYSTEM

2.2.1 Bus Expansion

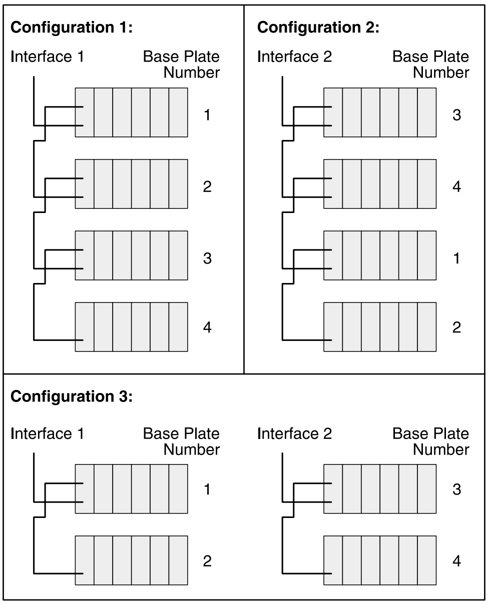
An expansion slave of a 2010 or 2005 system can be coupled to an expansion master of the other system. The following restrictions must be noted:

2005 to 2010

Expansion slaves on 2005 base plates can be connected directly to a 2010 expansion master (Max. 4 per 2010 system). For this type of expansion, both interfaces of the 2010 expansion master can be used. Only the following configurations are allowed for coupling 2005 components to a 2010 system.

Interface	Amount of Expansion Slaves		
	Configuration 1	Configuration 2	Configuration 3
Interface 1	4	0	2
Interface 2	0	4	2

Depending on the chosen configuration, the expansion base plate number must be addressed in the programming system with the following numbers:



2010 to 2005

I/O modules of the 2010 system can be connected to a 2005 expansion master in the CPU by means of an expansion slave or to a 2005 expansion slave (Expansion Slave OUT).

The module address of the 2010 expansion slave is set with the node number switch, from where the I/O module addresses begin. The installation must be in steps of ten (00, 10, ... 90). A maximum of 20 I/O modules can be installed on one of these bus segments. However, it is possible to use up to 99 modules with a 2010 expansion master.

2.2.2 Remote I/O Bus

A remote master (both 2005 and 2010) can be connected with up to 31 remote slaves. It is also possible to mix the two systems. Each remote slave begins a new I/O bus. The maximum number of slots for I/O modules depends on the type of slave.

2.3 CAN FIELD BUS

2.3.1 CAN Bus Features

- Low costs
- High noise immunity through differential signals
- Bus structure
- Open system
- Fast data transfer for small data packages (up to eight bytes)
- Error detection by means of CRC (Cyclic Redundancy Check) and frame testing -> Hamming distance 6
- Predictable transmission time for high priority messages (real time behaviour)
- Easy use

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2.3.2 Bus Length and Cable Type

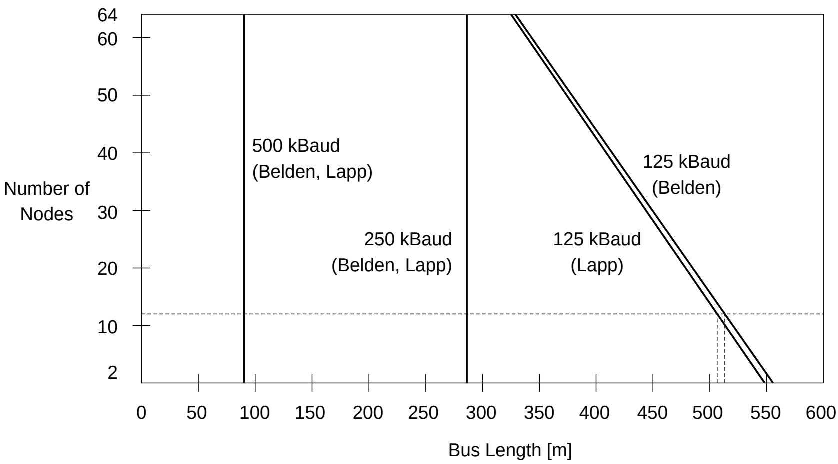
The type of cable used depends largely on the required length and the number of nodes. The bus length is decided principally by the bit rate.
The following bus lengths are permitted with a maximum oscillator tolerance of 0.121 %:

Expansion [m]	Rate of Transfer [kBit/sec]
7306 [1)]	10
3613 [1)]	20
1397 [1)]	50
658	100
510	125
215	250
67	500

[1)] In accordance with CiA (CAN in Automation) the maximum bus length is 1000 m.

B&R default values for different cable types defined by the number of nodes and bus lengths:

Cable 1	Belden YR 29832, 4.15 nsec/m
Cable 2	Lapp Cable 2170204, 4.15 nsec/m



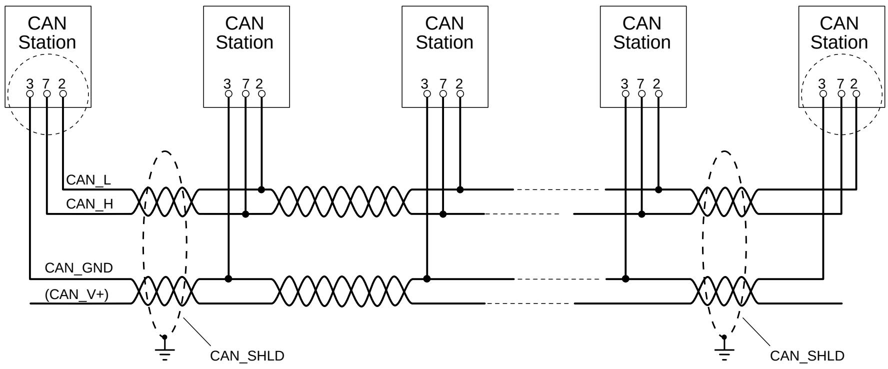
Example for 12 nodes:

Producer	Baudrate	Bus Length	Baudrate	Bus Length	Baudrate	Bus Length
Belden	500 kBaud	90 m	250 kBaud	286 m	125 kBaud	513 m
Lapp	500 kBaud	90 m	250 kBaud	286 m	125 kBaud	506 m

2.3.3 Cabling

Connection between Bus Cable - Station

For bus cable it is necessary to use 4 conductor twisted pair cable.



CAN Signals for CiA/CAL

CAN Signal	Description
CAN_GND	CAN Ground
CAN_L	CAN Low
(CAN_SHLD)	Shield
CAN_H	CAN High
(CAN_V+)	CAN Supply 8 - 15 V, optional

All CAN interfaces from B&R are supplied internally, therefore CAN_V+ does not have to be connected in CAN networks trhat donot contain devices from other manufacturers.

Branch Lines

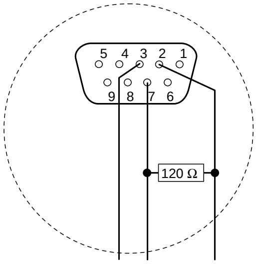
Branch lines should be avoided if possible. However, it is possible to connect nodes to the branch line as long as the distance is less than 30cm.

Termination Resistance

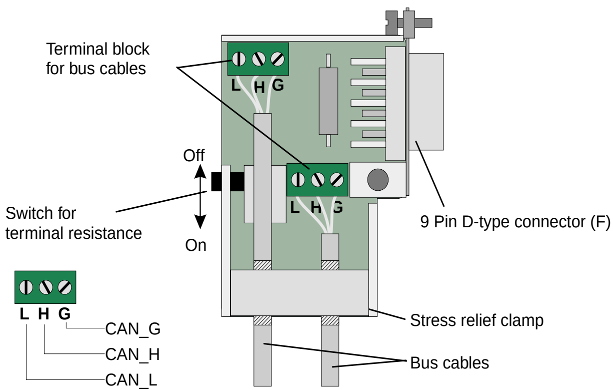
CAN networks are cabled using a bus structure, where both ends of the bus are equipped with termination resistors.

9 Pin D-type Connector (M)

For modules using a CAN interface, terminating resistor pins are assigned in the 9pin D-type (M) connector as shown in the following diagram.

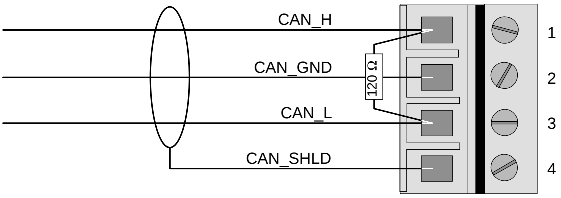


The terminating resistors are already integrated in CAN bus connectors 7AC911.9 provided by B&R. They can be turned on or off.



4 Pin Terminal Block

For modules using a CAN interface, terminating resistor pins are arranged in the 4 pin terminal block as shown in the following diagram.



A 4 pin terminal block and a 120 Ω terminating resistor are included with the delivery of the modules.

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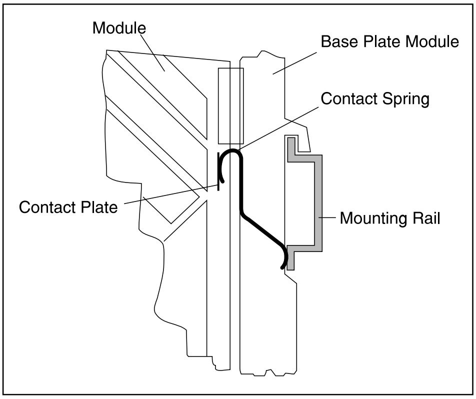
and Installation

3 GROUNDING AND SHIELDING

In most applications, the PCC is installed in a control cabinet. In these control cabinets there are various electromagnetic control elements (relays, contacts), transformers, motor controller, frequency converters, etc. Due to these elements, many different types of disturbances are inevitable. These disturbances cannot generally be prevented, however using the appropriate grounding, shielding and protective measures, negative influence on the PCC can be minimized. These protective measures include control cabinet grounding, module grounding, cable shield grounding, protecting electromechanical switching elements, correct wiring and use of cables, taking into account the cable type and thickness.



Grounding has two different functions:

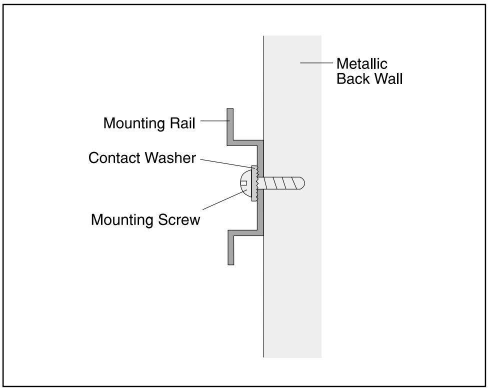
- ❍ Protective grounding
- ❍ To dissipate electromagnetic disturbance

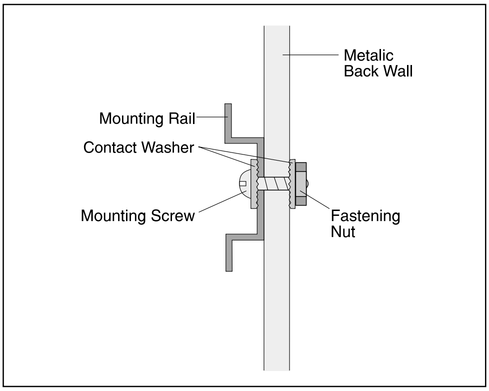
With the B&R 2000 control generation, both the dissipation of electromagnetic disturbance and the grounding is done through the mounting rail.

3.1 GROUNDING THE MOUNTING RAIL

For grounding purposes, a good conductive connection between the mounting rail and the metallic back wall is required. The mounting rail is often directly connected to the rear wall for better conduction. This is established by inserting a contact or toothed washer with the fastening screw:

If the rear wall is painted or coated, a sufficient connection is only possible if the screw thread is in contact with the rear wall. In this case, a contact washer must be inserted between the back of the rear wall and the fastening nut.



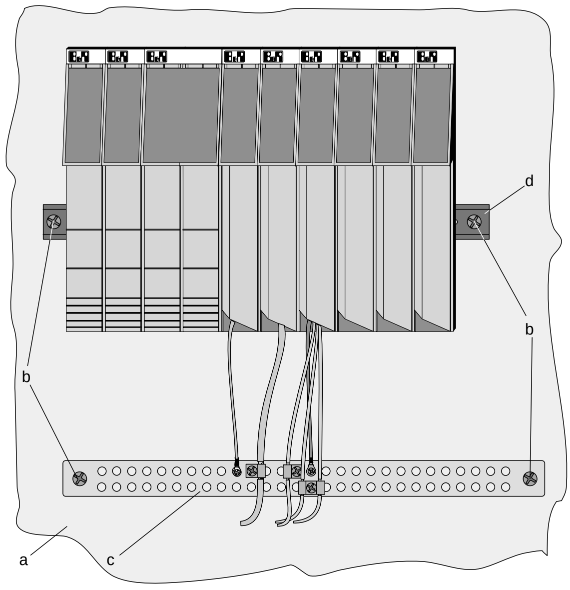


⚠ The control cabinet rear wall must always be connected with the earth potential (⏚).

3.2 GROUNDING TERMINALS

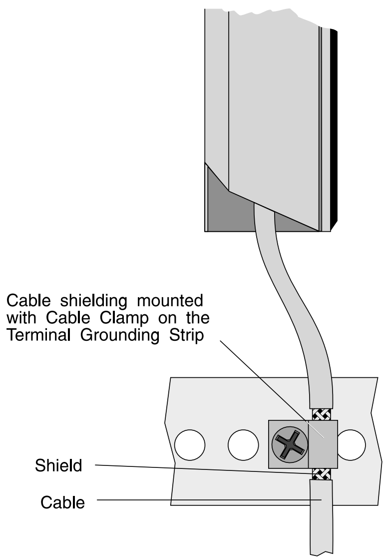
It is advisable to mount a grounding terminal strip underneath the PCC. This should be conductively connected to the screws of the control cabinet rear wall. The cable shield and module connections must also be attached to this grounding strip.

The distance between the grounding strip and PCC is limited to a maximum of 15 cm. No electromechanical switching elements (relays, contactors, etc.) are allowed between the PCC and grounding strip. Cable duct is usually mounted directly below the housing. A grounding strip should also be installed underneath bus expansions (I/O bus segments, remote I/O bus).



a .... Metallic grounded control cabinet back wall
b .... Conductive screw attachment to the control cabinet rear wall
c .... Grounding terminal strip
d .... Mounting rail

3.3 CABLE SHIELD GROUNDING



The following connections must be made with shielded cables (possible exceptions are given in the description for individual modules):

- ❍ Analog I/O
- ❍ Interface cables
- ❍ Encoder cables

The cable shield must be grounded at both ends. On the PCC side, the grounding is done to the terminal strip underneath the housing.

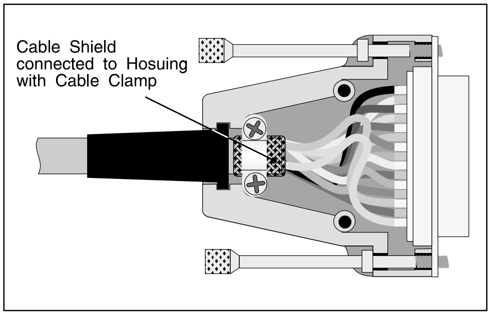
Should any potential differences exist between the PCC and connected elements, transient currents are generated over the cable shield (often connected with a warming of the cable). The following steps should be taken: the cable is removed and bridged by a high quality capacitor (ceramic or foil capacitor of at least 47 nF with a low impedance at high frequency).

3.4 USING D-TYPE CONNECTORS

D-type plugs must be equipped with a metal housing.

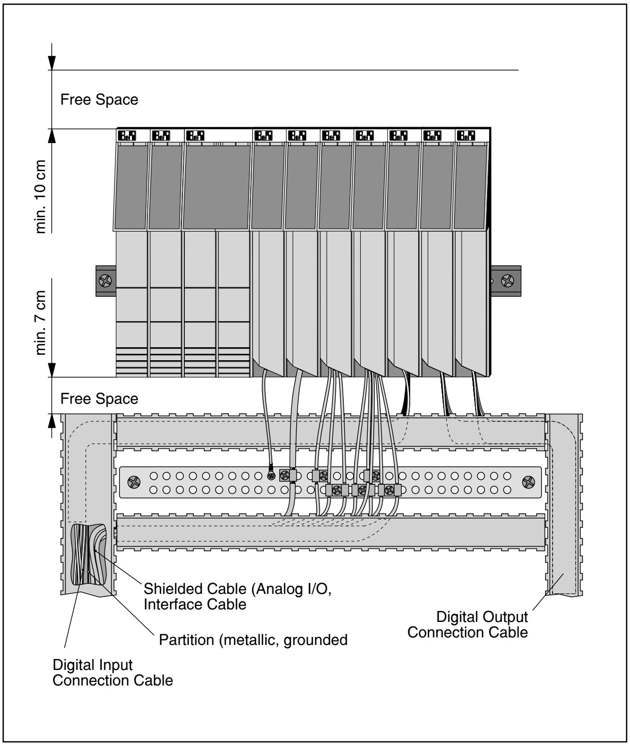
The shield is connected directly to the plug housing. Connecting the shield by twisting it and then attaching it considerably reduces its effect and should be avoided. It should be connected with the screw clamp that is provided in the housing

If there is no screw clamp available, the cable shield can be externally grounded using a clamp (see Cable Shield Grounding).



Cable Shielding in the D Type Plug

4 WIRING



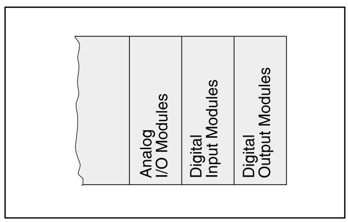
There are two basic types of cables used for the B&R 2000 control system:

❍ Shielded cables: interface cables, cables for analog signals, etc.

❍ Cables for digital signals

These two cable types should be separated, running through different channels. If cables of different groups are run in the same channel over a long distance, a metallic, grounded separation wall should keep them apart.

The proposed cable arrangement is only possible, if the order of the modules corresponds with:



5 EXTERNAL PROTECTION CIRCUITS

For relay output modules, external protection is recommended. The internal protection is used for increasing the life span of the relay and increases the EMC properties as well.

The external protection circuit can be installed either on the switching load or between the terminal block and load. Most manufacturers of contactors and magnetic valves offer special protection elements for their products.

The following elements may be used:

- RC Circuit: can be used for AC or DC.
- Varistor: usual used for AC.
- Diode: can only be used for DC.
- Diode/Z-Diode combination: can only be used for DC. This type of protection allows faster switch off time.

6 INSTALLATION GUIDELINES

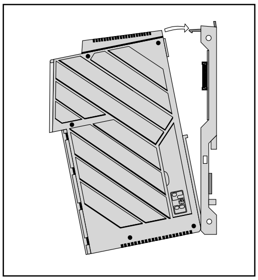
- The B&R 2000 controller are only be mounted horizontally. There must be free space left around the modules. A minimum of **10 cm** above and **at least 7 cm** underneath. The cooling vents may not be covered.
- The mounting rail should be screwed to the control cabinet rear wall approximately every 10 cm. This is for good conductance and to ensure that the load carrying capacity of the mounting rail is not exceeded.
- The maximum operating temperatures for each module (usually 60 °C) which is given in chapters "B&R 2010 Modules" and "B&R 2005 Modules" refer to the air temperature underneath the module.
- With devices causing strong electromagnetic disturbances (e.g. frequency converters, transformers, motor regulators, ...), it is sufficient to separate them spatially. The distance between these devices and the PCC should be as large as possible. If necessary, shielding should be done with an isolation sheet.

Module Insertion/Removal:

- Modules may never be inserted or removed while the PCC is turned on (except I/0 modules).
- All connectors (terminal block, D-type, etc.) to modules must be disconnected before the module is taken out.
- These connectors may not be inserted or removed if the they are still in use (all points must be turned off).

I/O Module Insertion/Removal while Controller is Running:

I/O modules of both systems may be inserted and removed under the following conditions:



- ❍ Connectors may only be removed if no signals are being transmitted.
- ❍ While inserting the module please note that it must take approx. 2 sec to tip the module back into place.
- ❍ Switching a module while in operation must be allowed through the software or else an emergency stop of the control system happens when the module is removed.

7 STORAGE AND STORAGE TEMPERATURES

For modules that do not have buffering batteries or rechargeable batteries, a storage temperature of -20 to +70 °C is allowed. For modules that have buffering batteries or rechargeable batteries, a storage temperature of -20 to +60 °C is allowed. Other temperatures are given in the technical data for the modules if necessary.

8 ENVIRONMENTAL TEMPERATURE DURING OPERATION / RELATIVE HUMIDITY

The following values are valid for all 2010 modules unless a different value is given for a module in the "Technical Data“ section.

Environmental Temperature during Operation	0 to 60°C
Relative Humidity	5 to 95 %, noncondensing

CHAPTER 3

B&R 2010 MODULES

1 MODULE OVERVIEW B&R 2010

Column 6 "Power" contains values for the power a module supplies or the power required by a module. In this way, a power balance can be calculated quickly and easily for each particular hardware configuration.

The power supplied by a power supply module is shown with a '+' sign. The power required by a module is shown with a '-' sign. Add the positive and negative power values to calculate the power balance. The sum is not allowed to be less than zero.

1.1 SORTED ALPHABETICALLY ACCORDING TO MODULE ID

Module ID	Description	Main BP	I/O Module	Expansion BP.	Power	Model No.	Page
AI300	16 voltage inputs ±10 V, 12 bit resolution		●		-9 W	2AI300.6	161
AI700	16 current inputs ±20 mA, 12 bit resolution		●		-9 W	2AI700.6	165
AI730	8 isolated current inputs 0 - 25 mA, 16 bit resolution		●		-6 W [1)]	2AI730.6	169
AO300	16 voltage outputs ±10 V, 12 bit resolution		●		-10 W	2AO300.6	208
AO725	8 current outputs 0...20 mA, 12 bit resolution		●		-10 W	2AO725.6	212
AO900	8 voltage outputs ±10 V, 8 current outputs 0...20 mA, 12 bit resolution		●		-12 W	2AO900.6	216
AT300	8 inputs for PT100 sensor (3 wire)		●		-9 W	2AT300.6	184
AT610	16 inputs for FeCuNi sensor type L + J, NiCrNi sensor type K, raw value measurement		●		-8 W	2AT610.6	191
BM100	Dummy module	●	●			2BM100.9	284
BP101	2 slots for system bus			●		2BP101.3	74
BP110	4 slots for system bus, incl. bus termination			●		2BP110.3	74
BP200	1 slot for I/O-Bus			●		2BP200.4	75
BP201	4 slots for I/O-Bus			●		2BP201.4	75
BP202	1 slot for expansion or remote slave; I/O bus			●		2BP202.4	75
BP210	1 slot for I/O bus, incl. bus termination			●		2BP210.4	75
BP300	2 slots for CPU, system and I/O bus, incl. bus termination			●		2BP300.4	76
CP100	CPU, 128 KByte DPR, 256 KByte system RAM				-10 W	2CP100.60-1	77
CP104	CPU, 128 KByte DPR, 256 KByte system RAM, CAN bus interface				-10 W	2CP104.60-1	77
CP200	CPU, 128 KByte DPR, 2 MByte system RAM, CAN bus interface				-20 W	2CP200.60-1	77
CP210	CPU, 128 KByte DPR, 6 MByte system RAM, CAN bus interface, MMU, FPU				-22.5 W	2CP210.60-1	77
DI400	32 digital inputs, 24 VDC, 10 msec switching delay, 8 interrupt capable inputs		●		-6 W	2DI400.6	109
DI425	32 digital inputs, 24 VDC, 10 msec switching delay		●		-6 W	2DI425.6	119
DI426	32 digital inputs, 24 VDC, 1 msec switching delay		●		-6 W	2DI426.6	119
DI725	32 digital inputs, 120 / 230 VAC, 50 msec switching delay		●		-4 W	2DI725.6	122
DI825	8 digital inputs, 12 V, 12 mA; 100 msec switching delay		●		-11 W	2DI825.6	127
DO428	32 transistor outputs, 24 VDC, 0.5 A		●		-5 W	2DO428.6	133
DO430	32 transistor outputs, 24 VDC, 2 A		●		-2.9 W	2DO430.6	139
DO600	32 relay outputs, 24 VDC / 120 VAC, 2 A		●		-8 W	2DO600.6	145
DO700	16 relay outputs, 24 VDC / 230 VAC, 3 A		●		-6 W	2DO700.6	149
DO710	8 change-over, 8 normally open, 30 VDC / 240 VAC, 4 A (resistive load)		●		-7 W	2DO710.6	153
DS100	Intelligent I/O processor, drum sequencer		●		-9 W [2)] -k x P_{enc}	2DS100.60-1	250
DS101	Intelligent I/O processor, drum sequencer with 32 transistor outputs		●		-13 W [3)] -k x P_{enc}	2DS101.60-1	257

Module ID.	Description	Main BP	I/O Module	Expansion BP.	Power	Model No..	Page
EX100	Remote master	●			-12 W	2EX100.50-1	234
EX200	Remote slave		●		-12 W	2EX200.50-1	234
EX301	Expansion slave		●		-3 W	2EX301.5	231
EX302	Expansion master		●		-3 W	2EX302.5	231
IF100	Interface module with three serial interfaces + CAN interface	●			-7 W	2IF100.60-1	242
IF101	Interface module with three serial interfaces + CAN + ETHERNET	●			-7 W	2IF101.60-1	242
ME910	Application memory (PCC software), 256 KByte FlashPROM, 64 KByte RAM					2ME910.90-1	91
ME913	Application memory (PCC software), 1024 KByte FlashPROM, 512 KByte RAM					2ME913.90-1	91
ME915	Application memory (PCC software), 2 MByte FlashPROM, 2 MByte RAM					2ME915.90-1	91
MP100	Multiprocessor, 64 KByte DPR, 256 KByte System-RAM	●			-12 W	2MP100.5	280
NC303	Path processor for ultrasonic transducer		●		-21 W -1.5 x P_{enc}	2NC303.60-1	270
NW100	PROFIBUS network module	●			-15 W	2NW100.50-1	238
PS425	power supply 24 VDC, 100 W		●		+100 W	2PS425.9	97
PS740	Power supply 100 - 240 VAC, 100 W		●		+100 W	2PS740.9	100
TB120	Terminal block, 20 pin					2TB120.9	105
TB140	Terminal block, 40 pin					2TB140.9	105
UM900	8 digital inputs, 1 msec switching delay 8 digital outputs, 24 VDC, 0.5 A 4 analog inputs, ±10 V / ±20 mA, 12 bit resolution 2 analog outputs, ±10 V (12 bit resolution) / 0...20 mA (11 bit resolution)		●		-8 W	2UM900.6	220

[1] One Watt must be deducted from every encoder supply used.

[2] Power consumption depends on the encoder supply used.
24 V encoder supply voltage: 9 W + 1.5 x encoder power
4.6 V encoder supply voltage: 9 W + 2.5 x encoder power

[3] Power consumption depends on the encoder supply used.
24 V encoder supply voltage: 13 W + 1.5 x encoder power
4.6 V encoder supply voltage: 13 W + 2.5 x encoder power

1.2 SORTED ACCORDING TO GROUP

Module ID	Description	Main BP	I/O Module	Expansion BP.	Power	Model No.	Page
	Base Plate Modules						
BP101	2 slots for system bus			●		2BP101.3	74
BP110	4 slots for system bus, incl. bus termination			●		2BP110.3	74
BP200	1 slot for I/O-Bus			●		2BP200.4	75
BP201	4 slots for I/O-Bus			●		2BP201.4	75
BP202	1 slot for expansion remote slave; I/O bus			●		2BP202.4	75
BP210	1 slot for I/O-Bus, incl. bus termination			●		2BP210.4	75
BP300	2 slots for CPU, system and I/O bus, incl. bus termination			●		2BP300.4	76
	CPUs						
CP100	CPU, 128 KByte DPR, 256 KByte system RAM				-10 W	2CP100.60-1	77
CP104	CPU, 128 KByte DPR, 256 KByte system RAM, CAN bus interface				-10 W	2CP104.60-1	77
CP200	CPU, 128 KByte DPR, 2 MByte system RAM, CAN bus interface				-20 W	2CP200.60-1	77
CP210	CPU, 128 KByte DPR, 6 MByte system RAM, CAN bus interface, MMU, FPU				-22.5 W	2CP210.60-1	77
	Application Memory						
ME910	Application memory (RPS-Software), 256 KByte FlashPROM, 64 KByte RAM					2ME910.90-1	91
ME913	Application memory (RPS-Software), 1024 KByte FlashPROM, 512 KByte RAM					2ME913.90-1	91
ME915	Application memory (RPS-Software), 2 MByte FlashPROM, 2 MByte RAM					2ME915.90-1	91
	Power Supplies						
PS425	Power supply 24 VDC, 100 W		●		+100 W	2PS425.9	97
PS740	Power supply 100 - 240 VAC, 100 W		●		+100 W	2PS740.9	100
	Digital Input Modules						
DI400	32 digital inputs, 24 VDC, 10 msec switching delay, 8 interrupt capable inputs		●		-6 W	2DI400.6	109
DI425	32 digital inputs, 24 VDC, 10 msec switching delay		●		-6 W	2DI425.6	119
DI426	32 digital inputs, 24 VDC, 1 msec switching delay		●		-6 W	2DI426.6	119
DI725	32 digital inputs, 120 / 230 VAC, 50 msec switching delay		●		-4 W	2DI725.6	122
DI825	8 digital inputs, 12 V, 12 mA; 100 msec switching delay		●		-11 W	2DI825.6	127
	Digital Output Modules						
DO428	32 transistor outputs, 24 VDC, 0,5 A		●		-5 W	2DO428.6	133
DO430	32 transistor outputs, 24 VDC, 2 A		●		-2.9 W	2DO430.6	139
DO600	32 relay outputs, 24 VDC / 120 VAC, 2 A		●		-8 W	2DO600.6	145
DO700	16 relay outputs, 24 VDC / 230 VAC, 3 A		●		-6 W	2DO700.6	149
DO710	8 change-over, 8 normally open, 30 VDC / 240 VAC, 4 A (resistive Last)		●		-7 W	2DO710.6	153
	Analog Input Modules						
AI300	16 voltage inputs ±10 V, 12 bit resolution		●		-9 W	2AI300.6	161
AI700	16 current inputs ±20 mA, 12 bit resolution		●		-9 W	2AI700.6	165
AI730	8 isolated current inputs 0 - 25 mA, 16 bit resolution		●		-6 W [1)]	2AI730.6	169
AT300	8 inputs for PT100-Fühler (3 wire)		●		-9 W	2AT300.6	184
AT610	16 inputs for FeCuNi sensor type L + J, NiCrNi sensor type K, raw value measurement		●		-8 W	2AT610.6	191
	Analog Output Modules						
AO300	16 voltage outputs ±10 V, 12 bit resolution		●		-10 W	2AO300.6	208
AO725	8 current outputs 0...20 mA, 12 bit resolution		●		-10 W	2AO725.6	212
AO900	8 voltage outputs ±10 V, 8 current outputs 0...20 mA, 12 bit resolution		●		-12 W	2AO900.6	216
	Mixed Modules						
UM900	8 digital inputs, 1 ms switching delay 8 digital outputs, 24 VDC, 0,5 A 4 analog inputs, ±10 V / ±20 mA, 12 bit resolution 2 analog outputs, ±10 V (12 bit resolution) / 0...20 mA (11 bit resolution)		●		-8 W	2UM900.6	220

Module ID.	Description	Main BP	I/O Module	Expansion BP.	Power	Model No.	Page
	Intelligent I/O Processors						
DS100	Intelligent I/O processor, drum sequencer		●		-9 W [2)] -k x P_{enc}	2DS100.60-1	250
DS101	Intelligent I/O processor, drum sequencer with 32 transistor outputs		●		-13 W [3)] -k x P_{enc}	2DS101.60-1	257
NC303	Path processor for ultrasonic transducer		●		-21 W -1.5 x P_{enc}	2NC303.60-1	270
	Multiprocessors						
MP100	Multiprocessor, 64 KByte DPR, 256 KByte system RAM	●			-12 W	2MP100.5	280
	Other Modules						
BM100	Dummy module	●	●			2BM100.9	284
EX100	Remote master	●			-12 W	2EX100.50-1	234
EX200	Remote slave		●		-12 W	2EX200.50-1	234
EX301	Expansion slave		●		-3 W	2EX301.5	231
EX302	Expansion master		●		-3 W	2EX302.5	231
IF100	Interface module with three serial interfaces + CAN interface	●			-7 W	2IF100.60-1	242
IF101	Interface module with three serial interfaces + CAN + ETHERNET	●			-7 W	2IF101.60-1	242
NW100	PROFIBUS network module	●			-15 W	2NW100.50-1	238
	Accessories						
TB120	Terminal block, 20 pin					2TB120.9	105
TB140	Terminal block, 40 pin					2TB140.9	105

1) One Watt must be deducted from every encoder supply used.

2) Power consumption depends on the encoder supply used.
24 V encoder supply voltage: 9 W + 1.5 x encoder power
4.6 V encoder supply voltage: 9 W + 2.5 x encoder power

3) Power consumption depends on the encoder supply used.
24 V encoder supply voltage: 13 W + 1.5 x encoder power
4.6 V encoder supply voltage: 13 W + 2.5 x encoder power

2 BASE PLATE MODULES

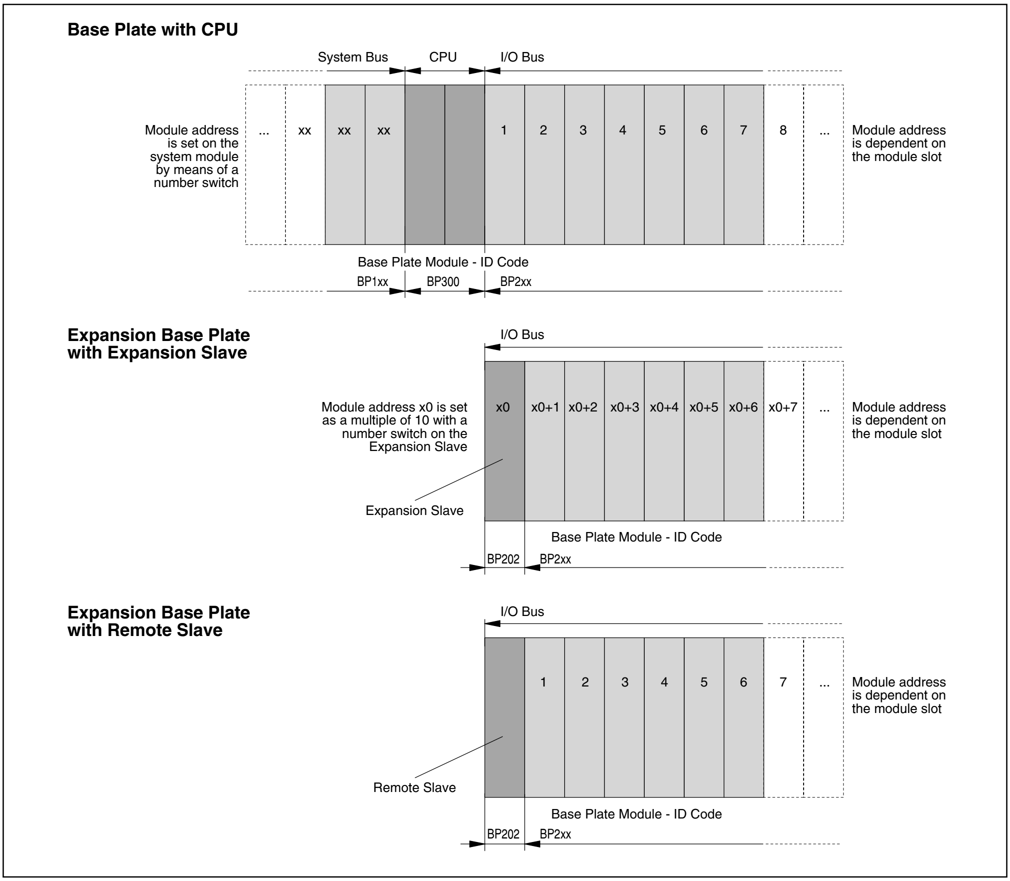
2.1 GENERAL INFORMATION

The base plates for the B&R 2010 system are modular. The individual base plate modules are installed on a mounting rail. The bus systems (I/O and system bus) and power lines are in the base plate modules. Due to the modular construction, base plates with different numbers of slots can be assembled as a single unit.

It is recommended that the smallest possible base plate modules be used, leaving the least number of slots free. All free slots must be filled with dummy modules.

Both the system and I/O bus must always end with a base plate module containing a terminator (Exception: System bus with two slots).

The **Module Address** of I/O modules is set by the slot (slot coding). The address numbering begins at slot 1 of the I/O bus with address 1. There is a 2 position, 7 segment display showing the module address on each I/O module. The module address of system modules is **not** slot dependant, but set with the dial switch on the module.

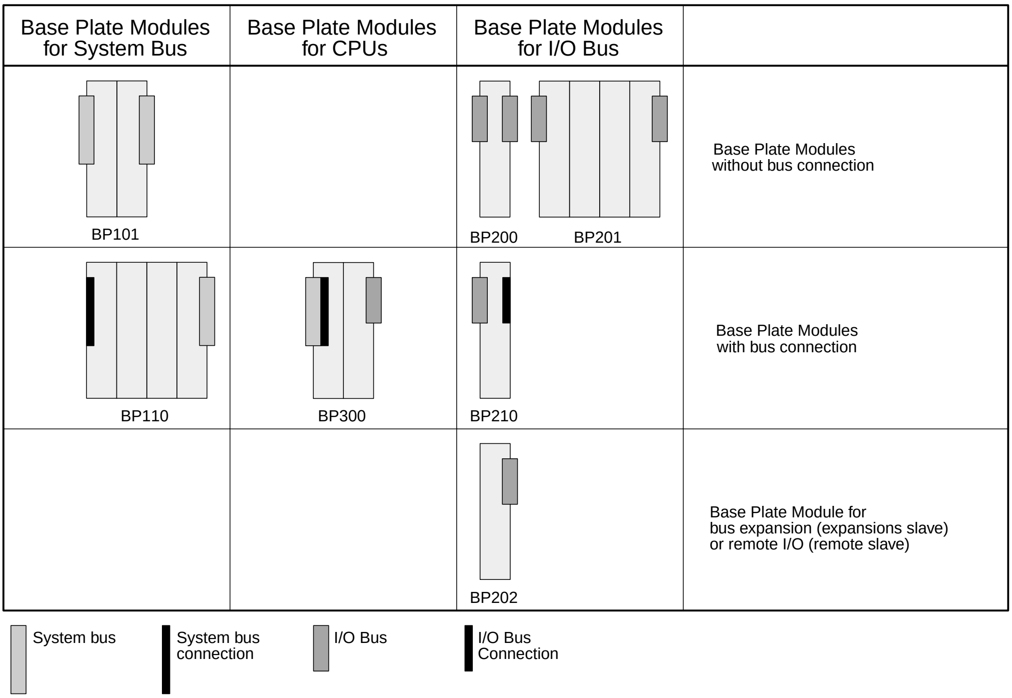


2.2 BASE PLATE MODULE CONFIGURATION

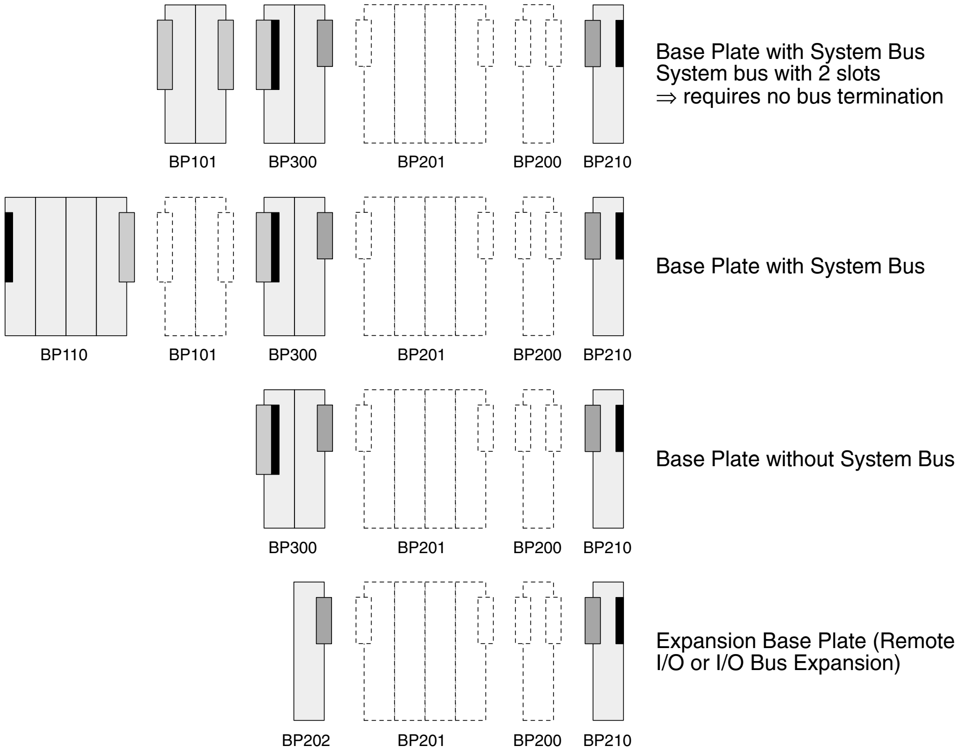
There are three different types of base plate modules:

- ❍ Main base plate module with system bus: BP110, BP210, BP300
- ❍ Main base plate module without system bus: BP101, BP200, BP201
- ❍ Expansion base plate module (remote I/O or I/O bus expansion): BP202

Different base plate modules are to be used depending on the base plate configuration. The following base plate modules are available (diagram):



The following modules are to be used for the various base plate configurations:



All modules in grey must be used for the respective configurations.
Modules shown with dotted outlines can be used one or more times to expand the base plate.

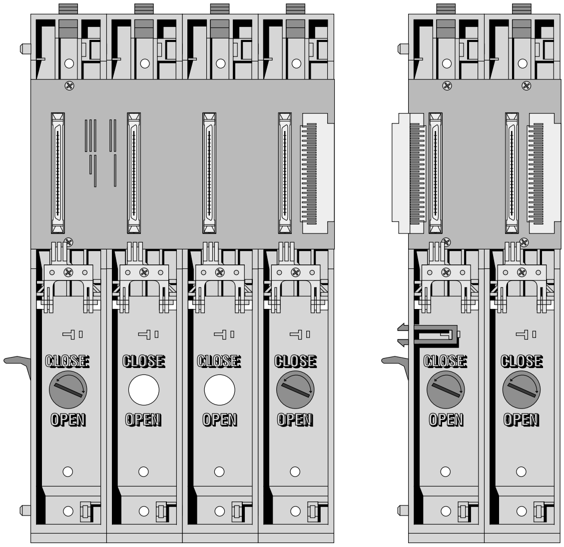
I/O bus base plate modules should be organized so that the single width modules are at the bus ends, and the quadruple width modules are located directly on the base plate module of the CPU.
If the configuration is started with this organization, time is saved expanding in the future.

Take note that the maximum number of slots for the base plate must not be exceeded:

System Bus: 8 Slots
I/O Bus: 20 Slots

2.3 BP101 / BP110

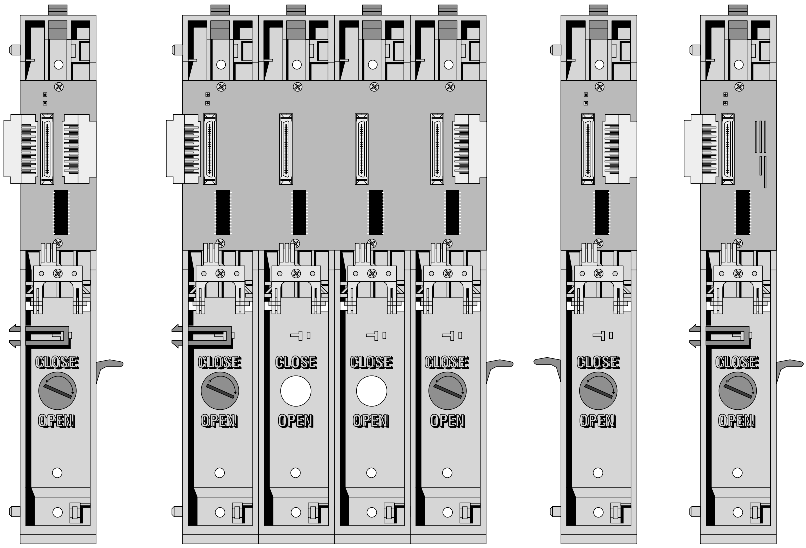
Technical Data



Module ID	**BP110**	**BP101**
Model Number	2BP110.3	2BP101.3
Description	2010 base plate module, 4 slots for system modules with bus termination for system bus	2010 base plate module, 2 slots for system modules
C-UL-US Listed	Yes	Yes
Number of Slots	4 system modules	2 system modules
Bus Termination	Yes (system bus)	No
Dimensions (H, W, D) [mm]	285, 160, 20	285, 80, 20

2.4 BP200 / BP201 / BP202 / BP210

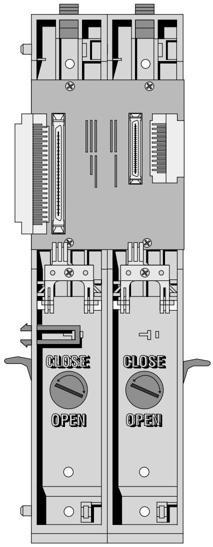
Technical Data



Module ID	BP200	BP201	BP202	BP210
Model Number	2BP200.4	2BP201.4	2BP202.4	2BP210.4
Description	2010 base plate module, 1 slot for I/O module	2010 base plate module, 4 slot for I/O module	2010 base plate module, 1 slot for expansion / remote slave	2010 base plate module, 1 slot for I/O module with bus termination for I/O bus
C-UL-US Listed	Yes	Yes	Yes	Yes
Number of Slots	1 I/O module	4 I/O modules	1 expansion slave or 1 remote slave	1 I/O module
Bus Termination	No	No	No	Yes (I/O bus)
Dimensions (H, W, D) [mm]	285, 40, 20	285, 160, 20	285, 40, 20	285, 40, 20

2.5 BP300

Technical Data



Module ID	BP300
Model Number	2BP300.4
Description	2010 base plate module, 2 slots for CPU with bus termination for system bus
C-UL-US Listed	Yes
Number of Slots	2 for 1 CPU
Bus Termination	Yes (system bus)
Dimensions (H, W, D) [mm]	285, 80, 20

3 CPUs

3.1 GENERAL INFORMATION

The CPU is operated on the BP300 base plate module. It requires two slots. A CPU cannot be used on an expansion unit.

3.2 TECHNICAL DATA

Module ID	CP100	CP104	CP200 / CP210
Model Number	2CP100.60-1	2CP104.60-1	2CP200.60-1/ 2CP210.60-1
Description	2010 CPU, 128 + 256 KB SRAM, 1 RS232 interface, 1 electrically isolated RS232/TTY, 1 electrically isolated RS485/RS422, RS485/RS422: network capable, Order application memory separately!	2010 CPU, 128 + 256 KB SRAM, 1 RS232 interface, 1 electrically isolated RS232/TTY, 1 electrically isolated CAN interface, CAN: network capable, Order application memory separately!	**CP200:** 2010 CPU, 128 + 2 MB SRAM, 1 RS232 interface, 1 electrically isolated RS232 1 electrically isolated RS485/RS422, 1 electrically isolated CAN interface, RS485/RS422 + CAN: network capable, Order application memory separately! **CP210:** 2010 CPU, 128 KB+6 MB SRAM, 2x4 KB Cache, MMU+FPU, 1 RS232 interface, 1 electrically isolated RS232, 1 electrically isolated RS485/RS422, 1 electrically isolated CAN interface, RS485/RS422 + CAN: network capable, Order application memory separately!
C-UL-US Listed	Yes	Yes	Yes
Base Plate Module	BP300	BP300	BP300
B&R ID Code	$20	$20	$50 / $51
Communication	RISC	RISC	RISC

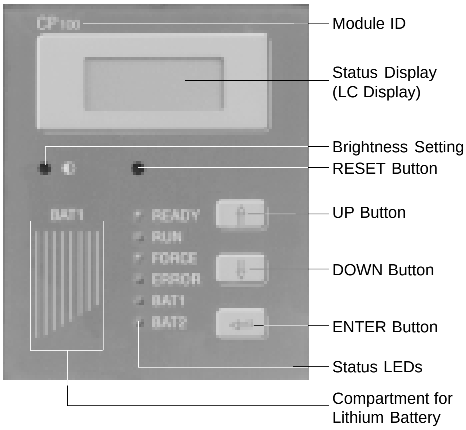
Module ID	**CP100**	**CP104**	**CP200 / CP210**
MMU and FPU	No	No	No / Yes
Command Cycle Time	0.8 µsec	0.8 µsec	0.125 µsec
Dual Ported RAM (DPR)	128 KByte SRAM	128 KByte SRAM	128 KByte SRAM
System RAM	256 KByte SRAM	256 KByte SRAM	2 / 6 MByte SRAM
Cache	No	No	2 *4 KByte
Application Memory (not incl.)	ME910 or ME913		
Real Time Clock Resolution	Nonvolatile, backup battery 10 msec		
RAM Buffering Lithium Battery (in CPU) Gold Foil Capacitor (in CPU) Battery Monitoring	 At least 2 years [1] At least 10 min Yes		
System Bus	Yes		
Key Switch	Yes		
Reset Button	Yes		
Three Configuration Buttons	UP, DOWN, ENTER; can be programmed by user		
Status Display	Alphanumeric LC Display (2 lines with 8 characters each), 6 Status LEDs		
Standard Communication Interfaces			
Application Interface (IF1) Isolation Connection Distance Baudrate	RS232 No 9 pin D-type plug max. 15 m / 19200 Baud max. 64 kBaud		
Application Interface (IF2) Isolation Connection Distance Baudrate	RS232 / TTY [2] Yes 9 pin D-type plug RS232: max. 15 m / 19200 Baud, TTY: max. 300 m max. 64 kBaud		RS232 Yes 9 pin D-type plug max. 15 m / 19200 Baud max. 64 kBaud
Application Interface (IF3) Isolation Connection Distance Baudrate	RS485 / RS422 [2] Yes 9 pin D-type plug max. 1200 m max. 347 kBaud	CAN Yes 9 pin D-type plug max. 1000 m Length 10 - 60 m: 500 kBits/sec Length 100 - 200 m: 250 kBits/sec Length 800 - 1000 m: 50 kBits/sec	RS485 / RS422 [2] Yes 9 pin D-type plug max. 1200 m max. 347 kBaud
Application Interface (IF4) Isolation Connection Distance Baudrate	----	----	CAN Yes 9 pin D-type plug max. 1000 m Length 10 - 60 m: 500 kBits/sec Length 100 - 200 m: 250 kBits/sec Length 800 - 1000 m: 50 kBits/sec
READY Relay Switching Voltage Nominal Maximum Max. Load on Contacts Transient Voltage Protection	Normally open 24 VDC / 230 VAC 30 VDC / 270 VAC 3 A 2 kV External protection required		
FORCE Relay Switching Voltage Nominal Maximum Max. Load on Contacts Transient Voltage Protection	Normally open 24 VDC / 230 VAC 30 VDC / 270 VAC 3 A 2 kV External protection required		
Power Consumption (incl. APM)	max. 10 W		max. 20 / 22,5 W
Storage Temperature	With APM inserted incl. lithium battery: -20 °C to +60 °C		
Dimensions (H, W, D) [mm]	285, 80, 185		

[1] A full battery has to be found in the APM, otherwise the buffer time is reduced to 1 year because the RAM in the APM is also buffered!

[2] The interface can be set with software.

3.3 STATUS AREA

The status area contains status LEDs, a 2-digit status display, various buttons and the lithium battery compartment.



3.3.1 Status LEDs

READY The CPU is running with no errors.

RUN The “RUN” LED lights if at least one application task is running. The LED goes out if the PCC is switched into service mode.

FORCE The “FORCE” LED lights if at least one process variable is set to a defined value (see Function **FORCE** of the PG2000 Programming System).

ERROR There is an error on the PCC or undefined status or the CPU was stopped (Service Mode). More information is shown on the LCD display.

BAT1 If this LED is lit, ...

..... the battery is missing, or

..... the voltage of the battery in the CPU is not enough to buffer the RAM if the PCC is not under power.

BAT2 If this LED is lit, ...

..... no lithium battery is available in the APM, or

..... the voltage from the lithium battery is not enough to buffer the RAM if the PCC is not under power.

The voltage of both batteries are monitored by the system software.

3.3.2 Status Display

The first line on the LCD display contains the versions number of the operating system software and boot type (coldstart - T, warmstart - I) as default (e.g. "V1.21 IN").
During PCC operation, an error number is shown if an error occurs (e.g. "FatalErr", 9100, "SERVICE" etc.). See "PG2000 Software User's Manual" (MASYS2PG-E).
The user has the possibility to freely select the messages that will be shown on the display using a function block (e.g. "POWER/OK" etc.).

The brightness of the LCD display can be set using a small screwdriver (2.5mm).

3.3.3 Configuration Buttons

UP Button

The following Boot modes can be set with the UP button:

1) Coldstart (T)

The **Coldstart** is actually a first initialization of the CPU. The operating system is restarted completely. All modules which are not stored in the application RAM are lost, allocated memory is cleared and the contents of the entire application RAM is deleted. The system structures (all information from the operating system for orderly CPU functionality) is recreated. All variables (inputs, outputs and flags) are initialized with a null value. Tasks found in the user EPROM or stored in the nonvolatile RAM, are started. All existing initialization sup-programs (INIT SPs) are executed.

2) Warmstart (I)

During a **Warmstart**, all battery buffered data (all tasks in the user-RAM, all flags, I/O data, etc.) is restored. This causes all tasks to have the same status as before the INIT (task started or task stopped). All existing initialization sub-programs INIT SPs) are executed.

ENTER Button

The selected boot procedure is executed when the ENTER button is pressed.

Software Evaluation

The three configuration buttons UP, DOWN and ENTER can also be freely programmed by the user and can be accessed in the program. See the "Library Reference Manual" (MASYS2LRM-E) and Section "2.5 Key Switch" in this manual for more information.

3.3.4 Diagnose Mode

If the UP and ENTER buttons are pressed when booting, the system goes into Diagnosis Mode. In Diagnosis Mode, the PCC only boots the operating system software. That means **all application programs are ignored** and are therefore inactive. After booting in Diagnosis Mode, the PCC goes into Service Mode.

After booting in Diagnosis Mode, the PCC can only be booted with a Coldstart or again in Diagnosis Mode (booting with Warmstart is not possible).

3.3.5 Reset Button

The Reset button can be pressed with any pointed object (e.g. a ballpoint pen). By pressing the reset button, a hardware reset is executed, i.e.:

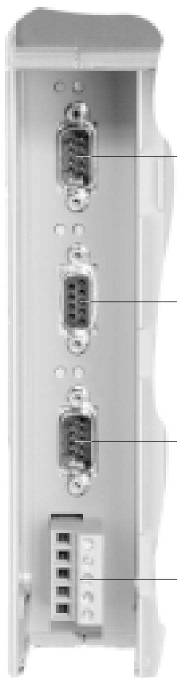
- All user programs are stopped.
- All outputs are set to zero.
- All multiprocessors in the system are also reset.

The PCC then goes into SERVICE mode.

3.4 CONNECTION AREA

Behind the module doors, you can find the serial interfaces (online interface), a terminal block for the FORCE and READY contacts, a key switch and the application memory slot:

Behind Left Module Door

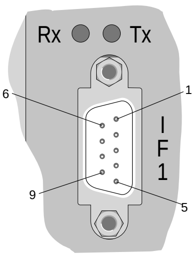


Behind Right Module Door

3.5 APPLICATION INTERFACE (IF1)

The non-electrically isolated IF1 application interface is also able to handle fibre optics connection. The fibre optics cable is supplied by a short circuit protected 4.8 V supply voltage (4.8 V ±6%, max. 150 mA) on pin 4 of the D-type connector (M).

3.5.1 CP100 und CP104

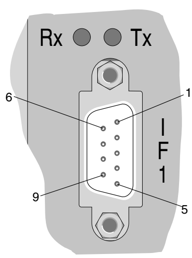
<table>
<tr><th>Interface</th><th>Description</th><th>Pin Assignments</th></tr>
<tr>
<td>Application Interface RS232


9 Pin D-Type Connector (M)</td>
<td>The standard RS232 interface is freely available for the user. IF1 is modem capable.

A standard RS232 cable is used for the online connection to PG. This cable is available from B&R:
<table><tr><th>Name</th><th>Model Number</th></tr><tr><td>RS232 Cable</td><td>0G0001.00-090</td></tr></table>
LEDs above the interface indicate if data is being sent (Tx) or received (Rx).

Max. Baudrate: 64 kBaud
Max. Cable Length: 15 m</td>
<td>
<table>
<tr><th></th><th colspan="2">RS232</th></tr>
<tr><td>1</td><td>DCD</td><td>Data Carrier Detect</td></tr>
<tr><td>2</td><td>RXD</td><td>Receive Signal</td></tr>
<tr><td>3</td><td>TXD</td><td>Transmit Signal</td></tr>
<tr><td>4</td><td>DTR</td><td>Data Terminal Ready
(+4.8 V / 150 mA)</td></tr>
<tr><td>5</td><td>GND</td><td>Ground</td></tr>
<tr><td>6</td><td>DSR</td><td>Data Set Ready</td></tr>
<tr><td>7</td><td>RTS</td><td>Request To Send</td></tr>
<tr><td>8</td><td>CTS</td><td>Clear To Send</td></tr>
<tr><td>9</td><td>RI</td><td>Ring Indicator</td></tr>
</table>
</td>
</tr>
</table>

3.5.2 CP200 and CP210

<table>
<tr><th>Interface</th><th>Description</th><th>Pin Assignments</th></tr>
<tr>
<td>Application Interface RS232


9 Pin D-Type Connector (M)</td>
<td>The standard RS232 interface is freely available for the user. IF1 is modem capable.

A standard RS232 cable is used for the online connection to PG. This cable is available from B&R:
<table><tr><th>Name</th><th>Model Number</th></tr><tr><td>RS232 Cable</td><td>0G0001.00-090</td></tr></table>
LEDs above the interface indicate if data is being sent (Tx) or received (Rx).

Max. Baudrate: 64 kBaud
Max. Cable Length: 15 m</td>
<td>
<table>
<tr><th></th><th colspan="2">RS232</th></tr>
<tr><td>1</td><td>NC</td><td></td></tr>
<tr><td>2</td><td>RXD</td><td>Receive Signal</td></tr>
<tr><td>3</td><td>TXD</td><td>Transmit Signal</td></tr>
<tr><td>4</td><td>DTR</td><td>Data Terminal Ready
(+4,8 V / 150 mA)</td></tr>
<tr><td>5</td><td>GND</td><td>Ground</td></tr>
<tr><td>6</td><td>DSR</td><td>Data Set Ready</td></tr>
<tr><td>7</td><td>RTS</td><td>Request To Send</td></tr>
<tr><td>8</td><td>CTS</td><td>Clear To Send</td></tr>
<tr><td>9</td><td>NC</td><td></td></tr>
</table>
</td>
</tr>
</table>

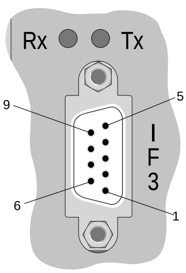
3.6 APPLICATION INTERFACE (IF3)

IF3 is a RS485/RS422 or as CAN interface depending on the CPU.

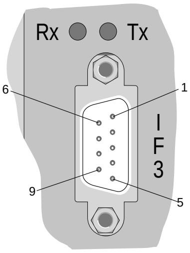
3.6.1 RS485/RS422 Interface (CP100, CP200 and CP210)

The electrically isolated interface is freely available to the user. The configuration is set with software in the application program.
The 5 V supply is electrically isolated and is used to connect termination resistors (when networking several RS485 interfaces).
LEDs above the interface indicate if data is being sent (Tx) or received (Rx).

Max. Baudrate: 347 kBaud
Max. Cable Length: 1200 m

Interface	Pin Assignments CP100			Pin Assignments CP200		
Application Interface RS485/RS422		**RS485**	**RS422**		**RS485**	**RS422**
	1	NC	NC	1	NC	NC
	2	res.	TXD	2	res.	TXD
	3	DATA	RXD	3	DATA	RXD
	4	NC	NC	4	res.	res.
	5	GND	GND	5	GND	GND
	6	+5 V / 200 mA	+5 V / 200 mA	6	+5 V / 200 mA	+5 V / 200 mA
	7	res.	$\overline{TXD}$	7	res.	$\overline{TXD}$
9 Pin D-Type Connector (F)	8	$\overline{DATA}$	$\overline{RXD}$	8	$\overline{DATA}$	$\overline{RXD}$
	9	NC	NC	9	res.	res.

3.6.2 CAN Interface (CP104)

Interface	Description	Pin Assignments	
			CAN
Application Interface CAN  9 Pin D-Type Connector (M)	The interface is electrically isolated. The node number is set with software. The connection is made using a T connector (7AC911.9). The INTEL 82527 processor is used as CAN Controller. Both status LEDs for receive and transmit above the male D-type connector indicate the activity of the CAN bus between controller and optocoupler. Max. Baudrate: 500 kBit/sec Bus Length: 10 - 60 m 250 kBit/sec Bus Length: 100 - 200 m 50 kBit/sec Bus Length: 800 - 1000 m	1	NC
		2	CAN L
		3	GND
		4	NC
		5	NC
		6	res.
		7	CAN H
		8	NC
		9	NC

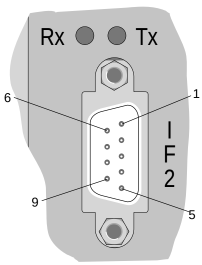
3.7 APPLICATION INTERFACE (IF2)

The electrically isolated interface is freely available to the user. The configuration is set with software in the application program.

LEDs above the interface indicate if data is being sent (Tx) or received (Rx).

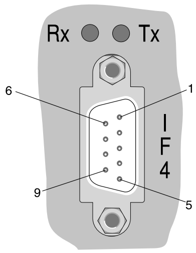
Max. Baudrate: 64 kBaud

Max. Cable Length: RS232: 15 m
TTY: 300 m ... only for CP100 and CP104!

Interface	Pin Assignments CP100, CP104			Pin Assignments CP200, CP210	
		RS232	**TTY**		**RS232**
Application Interface RS232/TTY  9 Pin D-Type Connector (M)	1	res.	TXD	1	res.
	2	RXD	Curr 1	2	RXD
	3	TXD	res.	3	TXD
	4	res.	RXD	4	res.
	5	GND	GND	5	GND
	6	res.	TXD Ret	6	res.
	7	RTS	Curr 2	7	RTS
	8	CTS	res.	8	CTS
	9	res.	RXD Ret	9	res.

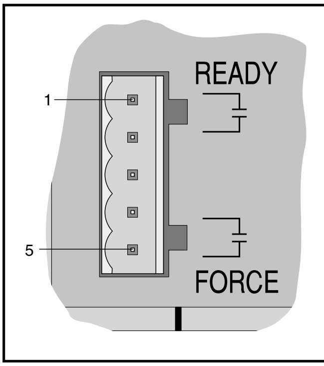
3.8 APPLICATION INTERFACE (IF4)

Only the CP200 and CP210 CPUs are equipped with this CAN interface.

Interface	Description	Pin Assignments	
			CAN
Application Interface CAN  9 Pin D-Type Connector (M)	The interface is electrically isolated. The node number is set with software. The connection is made using a T connector (7AC911.9). The INTEL 82527 processor is used as CAN controller. Both status LEDs for receive and transmit above the male D-type connector indicate the activity of the CAN bus between controller and optocoupler. Max. Baudrate: 500 kBit/sec Bus Length: 10 - 60 m 250 kBit/sec Bus Length: 100 - 200 m 50 kBit/sec Bus Length: 800 - 1000 m	1	NC
		2	CAN L
		3	GND
		4	NC
		5	NC
		6	res.
		7	CAN H
		8	NC
		9	NC

3.9 RELAY CONTACTS

A 5 pin PHOENIX connector can be found behind the left-hand module door which allows for the connection of two relays.

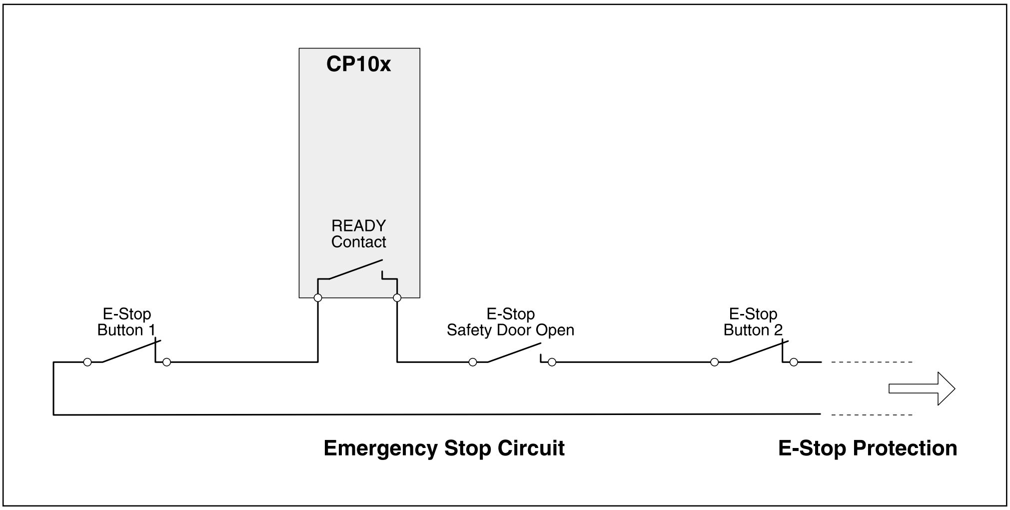


Pin	Connection
1	1 READY-Contact
2	2 Normally Open
3	
4	4 FORCE-Contact
5	5 Normally Open

3.9.1 READY Relay

This contact (normally open) can be used for an EMERGENCY STOP function. The relay reacts to a current loss when a reset occurs and when the entire PCC is stopped by the programming system. It can be set or reset by the operating system. Errors which cause the relay to open are defined in the operating system. It is also possible however, to define other errors that should cause the contact to open with the help of function blocks. The relay is linked with the "RUN" status LED on the CPU.

The READY relay contact can be added into the EMERGENCY STOP circuit:

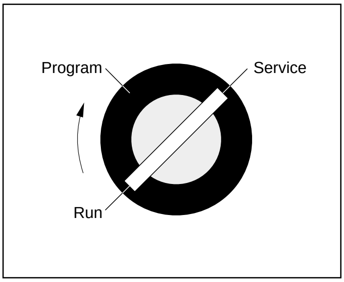


3.9.2 FORCE Relay

The FORCE relay contact is linked with the "FORCED" LED and is closed if at least one process variable is set to a defined value (**FORCE** function in the PG2000 programming system).

3.10 KEY SWITCH

The CP100 CPU has a three position key switch (The following description refers to version 1.10 and higher of the operating system PCC software.):



Run In this position it is not possible to transfer application programs to the CPU or to influence running applications from the programming system. The user only has limited status functions (reading and writing variables).

The UP/DOWN keys are inactive. The PCC can only be stopped by pressing the RESET key.

If the key is in this position during power-on, all tasks which are held in the application EPROM or application RAM are started.

Program Programs in the CPU can be started, stopped and deleted from the programming device/PG2000. All status function of the programming system are available for the user.

The MODE/SELECT keys are active. The PCC can be stopped by pressing the RESET key. Positions **Run** and **Program** can be switched between at any time while the PCC is running.

If the key switch is in this position at power-on, all tasks which are held in the application EPROM or application RAM are started.

Service If this position is switched to during PCC operations, the PCC is rebooted with a RESET, i.e. application programs are stopped and the all outputs are set to zero. Then the PCC goes into SERVICE mode. Only the system software runs in SERVICE mode, all application programs are inactive.

If the key switch is set to **Program** during PCC operation, the PCC reboots with the INIT boot mode (see section "Configuration Buttons").

If the key switch is in this position at power-on, the PCC goes automatically to SERVICE mode.

3.11 PROGRAMMING

The CPU is programmed using the programming system. Several programming languages are available:

- STL (statement list)
- LAD (ladder diagram)
- PL2000 (structured text)

3.12 RAM BUFFERING

3.12.1 General Information

RAM buffering backs up Application RAM, Dual Ported RAM and System RAM. When power to the PCC is lost, the lithium battery in the CPU or the application memory supplies the RAM in the CPU and APM.

3.12.2 Buffer Possibilities

RAM (program and data memory) is buffered by ...

- ... a lithium battery in the application memory module
- ... a lithium battery in the CPU
- ... a gold foil capacitor (during battery change)

3.12.3 Buffer Times

The following table contains an overview of buffer times if a full battery is being used.

Full Battery in		RAM Buffer Times
CPU	APM	
		10 min. with charged gold foil capacitor
	●	1 year for RAM in both modules
●		1 year for RAM in both modules
●	●	2 years for RAM in both modules

3.12.4 Battery Monitoring

The battery voltage is monitored cyclically. The cyclic load test does not shorten the battery life significantly but serves to give an early warning of weakened battery capacity.
The status information "Battery OK" is available from the B&R-TRAP function "SYS_battery".

3.13 CHANGING THE LITHIUM BATTERY

The lithium battery is found under the battery cover BAT1 near the status display.

Lithium Battery:	3 V / 950 mAh
Model Number:	0AC201.9 (5 lithium batteries)
Storage Time:	Max. 3 years at 30 °C (86° F)
Relative Humidity:	0 to 95 % (non-condensing)

The design of the product allows batteries to be changed regardless of whether the PCC is under power or not. However in some countries, changing batteries under operating power is not allowed. For this reason, B&R recommends batteries be changed when the PCC is not under power.
When changing the battery without power, the gold foil capacitor in the CPU and/or the lithium battery in the application memory supplies the RAM.

If application memory is not inserted, the following points are to be considered:

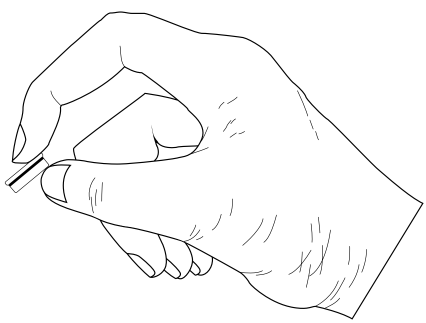
- To guarantee that the gold foil capacitor is charged, the PCC must be turned on for at least 5 minutes without interruption before changing the battery.

- After shutting down the system, the battery must be changed within 10 minutes.

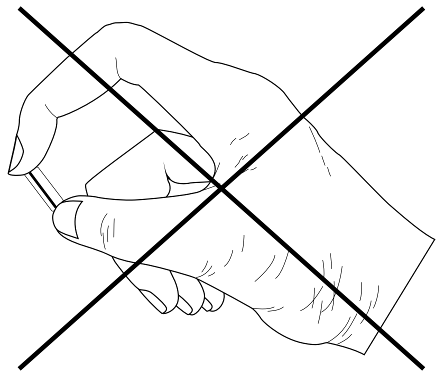
Procedure for Changing a Battery

1) Remove voltage to power supply
2) Discharge electrostatic energy by touching the mounting rail or the ground connection (not in the power supply!).
3) Open lithium battery cover and hold open
4) Pull the battery from the compartment using the removal ribbon
5) Remove lithium battery (do not use uninsulated tools to remove battery-> short circuit). The battery is only allowed to be held on the flat sides. <u>Insulated</u> tools can also be used to remove the battery.

Right:

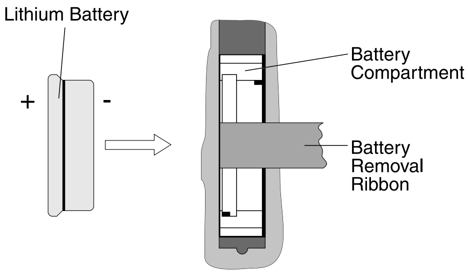


Wrong:



6) Insert new battery with correct polarity (don't forget to replace removal strip)
7) Close battery cover
8) Replace voltage to power supply

Lithium batteries are considered hazardous waste! Please dispose of batteries according to the guidelines in your area.



4 APPLICATION MEMORY

4.1 GENERAL INFORMATION

The application memory (APM) is required to store application programs. The APM modules are inserted into the slot provided in the processor module (CPU or multiprocessor). Operating system ROM, application RAM and application PROM are found in application memory. Both EPROM and also FlashPROM APM can be ordered from B&R.
For EPROM APMs, the operating system ROM **cannot** be deleted by the user. For FlashPROM APMs, the operating system is programmed in a System Flash. The operating system can be downloaded or updated using the programming system (see section "Programming System Flash").

An APM module is only allowed to be inserted or removed when power is turned off.

The buffer time of the lithium battery is influenced by storage or operating temperature. Proper storage of the battery (cool and dry) is recommended so that the buffer time is not negatively influenced.

4.2 TECHNICAL DATA

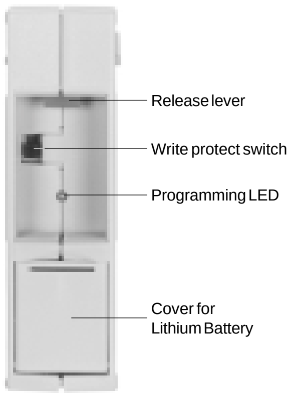
Module ID	**ME910**	**ME913**	**ME915**
Model Number	2ME910.90-1	2ME913.90-1	2ME915.90-1
Description	2010 Application Memory, 64 KB SRAM, 256 KB FlashPROM with PCC operating system	2010 Application Memory, 512 KB SRAM, 1 MB FlashPROM with PCC operating system	2010 Application Memory, 2 MB SRAM, 2 MB FlashPROM with PCC operating system
C-UL-US Listed	Yes	Yes	Yes
Used for Processor Module	CP10x, CP2x0, MP100	CP10x, CP2x0, MP100	CP10x, CP2x0, MP100
Operating System	PCC-Software	PCC-Software	PCC-Software
User RAM	64 KByte SRAM	512 KByte SRAM	2 MByte SRAM
User PROM	256 KByte Flash	1024 KByte Flash	2 MByte Flash
Erasing PROM	Programming logic in module		

Module ID	ME910	ME913	ME915
FlashPROM Programming	Programming logic in module, LED display		
Write Protection	Switch on module		
Buffering RAM Lithium Battery (in APM) Gold Foil Capacitor (in APM)	 At least 2 years [1] At least 10 min.		
Storage Temperature APM without Lithium Battery APM with Lithium Battery Lithium Battery (not installed)	 -20 to +70 °C -20 to +60 °C -20 to +60 °C		
Storage Time Lithium Battery (not installed)	 Max. 3 years at 30 °C		
Dimensions (H, W, D) [mm]	103, 32, 122		

[1] The buffer times given refer to application memory modules that are not installed in a processor module (CPU or Multiprocessor). Otherwise, the buffer time is reduced to 1 year since the processor module RAM is also buffered.

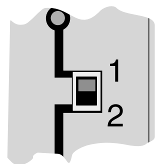
4.3 LED AND OPERATIONAL ELEMENTS

The following operational elements are found on the front side of the application memory module:



The **Programming LED** is lit if a the application PROM is written to ("burning").

The **Write Protect Switch** is used to protect the PROM from being accidentally written to or deleted.
In position 1 (write position), you can write to the application PROM. In Position 2, writing to or deleting from the PROM is not allowed.



The position of the write protection switch is not allowed to be changed while programming B&R modules to application PROM!

A lithium battery is found behind the **Battery Cover** which supplies the application RAM **and** the RAM in the processor module (CPU and multiprocessor) when power is removed.

When the APM is stored for long periods of time, the battery should be removed if buffering is not needed to prevent unnecessary discharge.

To remove the APM from the processor module (CPU or multiprocessor), the **Removal Lever** must be pressed lightly downwards.

4.4 CHANGING THE LITHIUM BATTERY

Lithium Battery: 3 V / 950 mAh
Model Number: 0AC200.9 (5 lithium batteries)

Storage Time: Max. 3 years at 30 °C
Relative Humidity: 0 to 95 % (non-condensing)

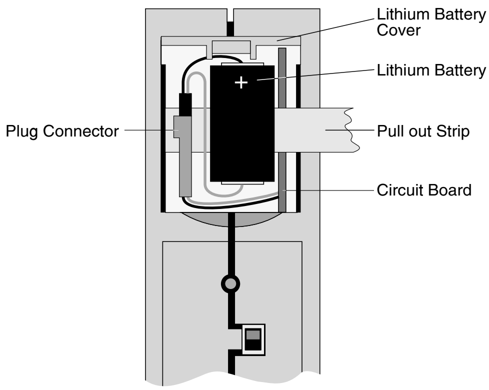
The design of the product allows batteries to be changed regardless of if the PCC is under power or not. However in some countries, changing batteries under operating power is not allowed. For this reason, B&R recommends batteries be changed when the PCC is not under power.
Changing the lithium battery can be done while the APM is inserted or removed. A gold foil capacitors takes over buffering the RAM on the APM, a gold foil capacitor or a lithium battery takes over buffering the RAM on the CPU.

If application memory is not inserted, the following points are to be considered:

- ❍ To guarantee that the gold foil capacitor is charged, the PCC must be turned on for at least 5 minutes without interruption before changing the battery.
- ❍ After shutting down the system, the battery must be changed within 10 minutes.

Procedure for Changing a Battery

1) Remove voltage to power supply
2) Discharge electrostatic energy by touching the mounting rail or the ground connection (not in the power supply!).
3) Open lithium battery cover and hold open
4) Pull the battery from the compartment using the removal ribbon
5) Disconnect plug (angle slightly)
6) Remove used battery
7) Insert new battery
8) Replace plug (angle slightly)
9) Place battery in compartment (don't forget to replace removal ribbon)
10) Place the remaining bit of removal ribbon between battery and housing
11) Close lithium battery cover
12) Replace voltage to power supply



Lithium batteries are considered hazardous waste! Please dispose of batteries according to the guidelines in your area.

4.5 PROGRAMMING SYSTEM FLASH

4.5.1 General Information

All application memory is delivered without an operating system. An operating system download or a operating system update is carried out with the help of the programming system.

An operating system installation with PG2000 is possible with versions 2.20 or higher.

4.5.2 Operating System Download

All application memory is delivered without an operating system. The following steps should be followed when installing the operating system ("operating system download") for the first time:

1) Switch off voltage supply to PCC. This step is necessary because the application memory must only be inserted when the power is switched off.

2) Insert the new FlashPROM application memory and switch power back on. Do not forget that the write protection switch on the front of the application memory is set to write position.

3) Establish online connection between programming device (PC or Industrial PC) and CPU.

4) Start programming system PG2000

5) Call up the PCCSW update function in PG2000 (see menu item service in the pull down menu system).

6) A dialog box appears in which the baudrate for the download procedure and the PC interface (to be used for the online connection) can be defined (e.g. 57600 baud, COM1).

7) Selecting [OK] opens the next dialog box,

8) In this box, the operating system version can be selected. After closing this box (by choosing "Yes"), the download procedure begins. The progress of the download procedure is displayed in the message line.

The User Flash is deleted !

9) When the download procedure has finished the PCC must be switched off and on again.

10) The PCC is now ready for operation.

4.5.3 Operating System Update

On the CP100 CPU, the operating system update can only be carried out via application interface IF1!

When updating the operating system, the following steps should be taken:

1) Turn off the supply voltage to the PCC. This step is necessary because the application memory can only be inserted when the power is switched off.

2) Remove the application memory from the CPU or multiprocessor

3) An operating system update is only possible if the CPU is in bootstraploader mode. Open the FlashPROM side panel of the application memory and set the hardware switch to "ERASE".

4) Re-insert application memory into the CPU or multiprocessor and return power. Do not forget that the write protection switch on the front of the application memory is set to the write position.

5) Establish online connection between the programming device (PC or industrial PC) and the CPU.

6) Start PG2000.

7) Call up the PCCSW update function in PG2000 (see menu item "Service" in the pull down menu "System").

8) A dialog box appears in which the baudrate for the update procedure and the PC interface (to be used for the online connection) can be defined (e.g. 57600 baud, COM1).

9) Selecting OK opens the next dialog box.

10) In this box the operating system version can be selected. After closing this box (by choosing "Yes"), the system ROM is deleted (incl. operating system). The selected version of the operating system is then transferred into the system ROM. The progress of the download procedure is displayed in the message line.

The User Flash is deleted !

11) When the update procedure is finished, the PCC has to be turned off.

12) Remove the application memory from the CPU and set the hardware switch to "OK"

13) Re-insert the application memory into the CPU and apply power again.

14) The PCC is now ready for operation.

5 POWER SUPPLY MODULES

5.1 GENERAL INFORMATION

The power supply modules of the B&R 2005 controller generation produce the necessary secondary voltage from a variety of input voltages (24 VDC, 120 VAC, 230 VAC or 230 VAC / 220 VDC). Every main and expansion rack requires at least one power supply module. Power supply modules can only be inserted on the I/O bus (never on the system bus).
The relevant characteristic for power supply modules is the input voltage.
When configuring a system, make sure that the power consumption of all the inserted modules does not exceed the output power of all power supply modules in the system.
The supply power for the B&R SYSTEM 2010 can created using any number of power supply modules (redundancy possible) in almost any slot in the entire system. The power supply modules can be inserted and removed under power.

5.1.1 Security Measures

Power supply modules are equipped with internal current limitation (short circuit protection) and a thermal overload protection. A fuse protects the module against overload and reverse polarity. The fuse can be found behind the module door.
A READY relay can monitor the function of a power supply module. The READY relay closed when the power supply is functioning properly. If an error occurs (e.g. overload), the relay opens. The READY relay can be used for external monitoring of the supply.

5.1.2 Overview

Power Supply	Input Voltage	Output Power
PS425	24 VDC	100 W
PS740	90 ... 270 VAC	100 W

5.1.3 Slots

The supply concept of the B&R 2010 system is modular. One or more power supplies are used to meet the requirements of the installed modules. The power supplies can be operated in every slot of the I/O bus. B&R recommends that a power supply be inserted in the right-most slot of the I/O bus using the method described in chapter "Project Planning and Installation" section "System Configuration and Power Supply".

5.2 PS425

5.2.1 Technical Data

Module ID	PS425
Model Number	2PS425.9
Description	2010 Power Supply Module, 24 VDC, 100 W
C-UL-US Listed	Yes
Base Plate Module	BP200, BP201, BP210
Input Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
External Backup Capacitors with Single Phase Bridge with Three Phase Bridge	 20000 µF 12000 µF
Output Power	100 W
Current Requirements	Max. 6.5 A
Protective Measures Fuse Thermal Overload Protection Current Limitation	 10 A slow-blow / 250 V Monitors Housing Temperature Monitors output power
Status Display	LEDs
READY Relay Switching Voltage Max. Load on Contact Transient Voltage Protection	N.O. Nom. 24 VDC / 230 VAC 2 A 2.5 kV External
Dimensions (H, W, D) [mm]	285, 40, 185

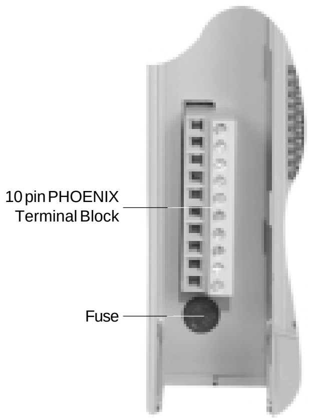
5.2.2 Status LEDs

DC The secondary power supplied is OK.

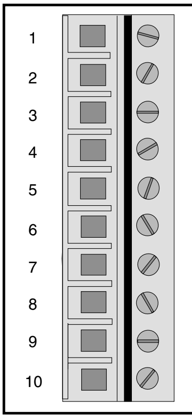
OL This LED (OVERLOAD) lights if the current limitation is activated. Possible causes are:

- ❍ The temperature within the housing is too high.
- ❍ More power is required by the PCCs than the power supply can deliver (Maximum output power is exceeded).

5.2.3 Connection



10 Pin Terminal Block



Pin	Termination
1	1 Normally open
2	2 READY contact
3	
4	
5	
6	
7	Shield ground
8	+24 V
9	GND
10	Shield ground

The **READY Contact** is closed if the power supply is operating properly. If the power supply is overloaded the contact is opened. This allows an external monitor power supply monitor to be installed.

Fuse

The power supply is equipped with a **fuse** on the primary side.

Glass Fuse 5 * 20 mm: 10 A slow blow / 250 V

The supply voltage to the power supply must be removed before changing the fuse.

Procedure to change a fuse:

1) Remove supply voltage to power supply
2) Discharge electrostatic by touching the mounting rail or ground connection (not in the power supply!).
3) Open module door
4) Loosen fuse holder using a screwdriver
5) Remove fuse holder
6) Remove old fuse from fuse holder
7) Place new fuse in the fuse holder
8) Place fuse holder into the power supply module
9) Tighten fuse holder using a screwdriver in the direction of the arrow
10) Close module door
11) Replace supply voltage to power supply

5.2.4 Overload Protection

The following are monitored during operation:

- The temperature inside the power supply housing (thermal overload protection)
- Power supplied to the PCC (current limitation)

If either the thermal overload protection or current limitation is active, ...

... a power breakdown of the entire PCC system occurs

... the **OL** (OVERLOAD) LED is lit

... the READY contact is opened

Only when the power consumption drops below the maximum output power of the power supply again or the temperature drops into the range permitted within the power supply housing is the current supply reactivated.

5.3 PS740

5.3.1 Technical Data

Module ID	PS740
Model Number	2PS740.9
Description	2010 Power Supply Module, 100-240 VAC, 100 W
C-UL-US Listed	Yes
Base Plate Module	BP200, BP201, BP210
Input Voltage Minimum Nominal Maximum	 90 VAC 100 ... 240 VAC 270 VAC
Input Voltage Frequency	47 to 63 Hz
Overvoltage Peak Value Half Value duration	 750 V 1.3 msec non-periodic
Output Power	see Diagram "Output Power"
Current Requirements	Max. 1.1 A
Protective Measures Fuse 1,6 A slow-blow / 250 V Thermal Overload Protection Current Limitation	 Monitors housing temperature Monitors output power
Status Display	LEDs
READY Relay Switching Voltage Max. Load on Contact Transient Voltage Protection	N.O. Nom. 24 VDC / 230 VAC 2 A 2.5 kV External
Dimensions (H, W, D) [mm]	285, 40, 185

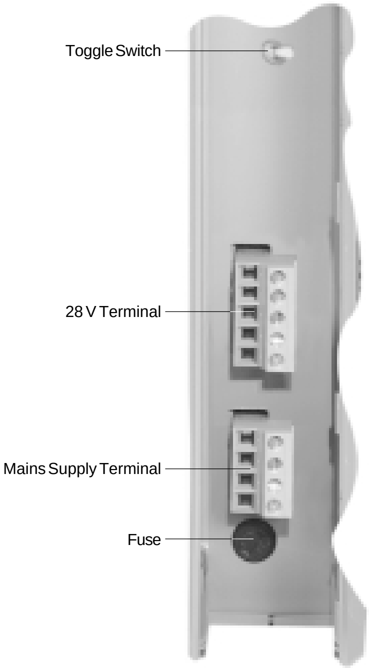
5.3.2 Status LEDs

DC The secondary power supplied is OK.

OL This LED (OVERLOAD) lights if the current limitation is activated. Possible causes are:

- ❍ The temperature within the housing is too high.
- ❍ More power is required by the PCCs than the power supply can deliver (Maximum output power is exceeded).

5.3.3 Connection

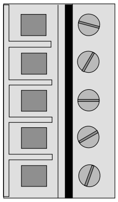


The secondary voltage produced (28 V) can be switched as required to either the I/O bus (PCC system) or to the 28 Volt terminal block by means of the **Toggle Switch**. This makes it possible to supply external I/O components with the same power supply:

Toggle Switch	Secondary voltage
Left Right	28 V to I/O bus 28 V to 5 pin PHOENIX connector

The toggle cannot be switched while the power supply is supplied with power. Using the toggle switch to switch off the PCC is not allowed.

28 V Terminal Block

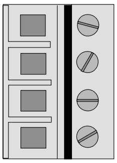


Pin	Termination
1	+28 V
2	GND
3	
4	4 Normally open
5	5 READY contact

The **28 V Supply** which is available through this 5 pin terminal block is also overload protected. If this protection is active, the power supply must cool down with the power off for a few minutes until it can be put into operation again.

The **READY Contact** is closed if the power supply is operating normally. If the power supply is overloaded, the contact is opened. This makes it possible to put an external monitor on the current supply.

Supply Voltage Terminal Block



Pin	Termination	
1	PE	Shield Ground
2		
3	N	Neutral
4	L1	Line

Fuse

The power supply is equipped with a **fuse** on the primary side.

Glass Fuse 5 * 20 mm: 1.6 A slow blow / 250 V

The supply voltage to the power supply must be removed before changing the fuse.

Procedure to change a fuse:

1) Remove supply voltage to power supply
2) Discharge electrostatic by touching the mounting rail or ground connection (not in the power supply!).
3) Open module door
4) Loosen fuse holder using a screwdriver
5) Remove fuse holder
6) Remove old fuse from fuse holder
7) Place new fuse in the fuse holder
8) Place fuse holder into the power supply module
9) Tighten fuse holder using a screwdriver in the direction of the arrow
10) Close module door
11) Replace supply voltage to power supply

5.3.4 Overload Protection

The following are monitored during operation:

- ❍ The temperature inside the power supply housing (thermal overload protection)
- ❍ Power supplied to the PCC (current limitation)

If either the thermal overload protection or current limitation is active, ...

... a power failure for the entire PCC system occurs

... the **OL** (OVERLOAD) LED is lit

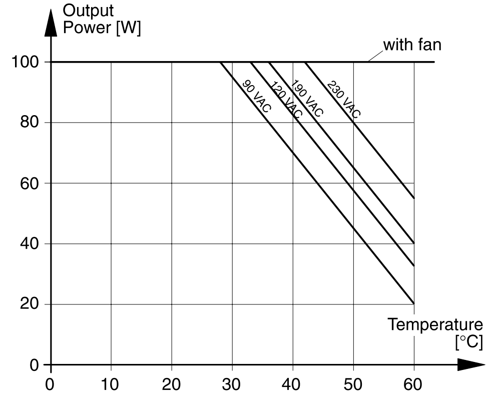
... the READY contact is opened

Only when the power consumption drops below the maximum output power of the power supply again or the temperature drops into the range permitted within the power supply housing is the current supply reactivated.

Chapter 3
B&R 2010 Modules

5.3.5 Output Power

The output power of the PS740 power supply sinks with falling input voltage or increasing operating temperature (because of the internal temperature monitor). This must be taken into account while planning for power requirements.



6 TERMINAL BLOCKS

6.1 GENERAL INFORMATION

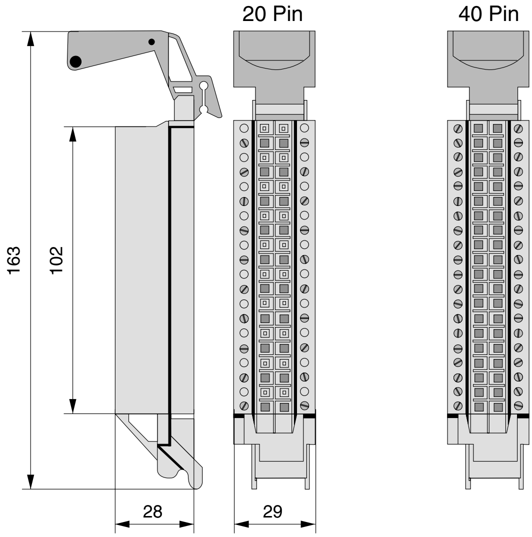
Modules within the B&R 2010 control generation are connected to other control elements using double row terminal blocks.

The following advantages are achieved through the special construction of the terminal blocks:

- Whether the terminal block is properly connected is indicated by means of a status LED on each and every module. This information can also be evaluated through the application program.
- The terminal block can be coded so as to prevent accidental connection to the wrong I/O module (see chapter "Project Planning and Installation" section "Dimensions and Installation").
- The terminal block is easily removed with a built-in ejection lever (see chapter "Project Planning and Installation" section "Dimensions and Installation").

To prevent damage, a stress relief should be used for the I/O cable.

6.2 TECHNICAL DATA



Module ID	TB120	TB140
Model Number	2TB120.9	2TB140.9
Description	2010 Terminal Block, 20 pin, screw clamps	2010 Terminal Block, 40 pin, screw clamps
Number of Pins	20	40
Clamp Type	Screw clamps (3.5 mm screw driver)	
Distance between Contacts Terminal / Terminal Left / Right Row	 10.16 mm 6.38 mm	 5.08 mm 6.38 mm
Creeping Distance Terminal / Terminal Left / Right Row	 8.28 mm 4.5 mm	 3.2 mm 4.5 mm
Nominal Voltage [1)]	250 VAC according to VDE Group C	
Current Load[1)]	Max. 12 A / contact	
Dielectric Strength[1)] Terminal / Terminal Left / Right Row	 >5 kV 5 kV	 3,5 kV 5 kV
Wire Cross Section	0.20 mm^2 (AWG24) - 2.5 mm^2 (AWG12)	
Cable Type	Only copper wire (**no** aluminium wires!)	
Removal	Mechanical	
Stress Relief	Cable ties	

1) The respective limit data for the I/O modules has to be taken into consideration!

7 DIGITAL INPUT MODULES

7.1 GENERAL INFORMATION

Digital input modules are used for converting binary signals of a process in the signal levels required for the PCC. The states of the digital inputs are indicated with LEDs.

The relevant characteristics for input modules are:

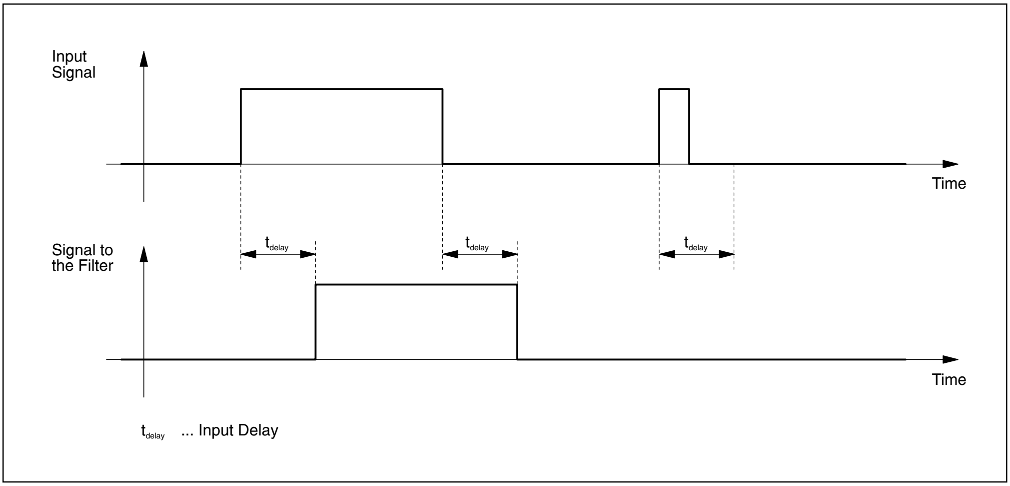
- Number of Inputs
- Input Voltage
- Input Delay (Filter)
- Special Functions (e.g. counter inputs)

7.1.1 Overview

Module	Number of Inputs	Input Voltage	Input Circuit Switching Range / Hysteresis	Input Delay	Remarks
DI400	32	24 VDC		10 msec	8 CSI Inputs 4 Counter Inputs
DI425	32	24 VDC		10 msec	
DI426	32	24 VDC		1 msec	
DI725	32	120 / 230 VAC		50 msec	
DI825	8		1.2 to 2.1 mA / typ. 0.5 mA	100 µsec	Ignition Protection **[EEx ia] IIC**

7.1.2 Timing

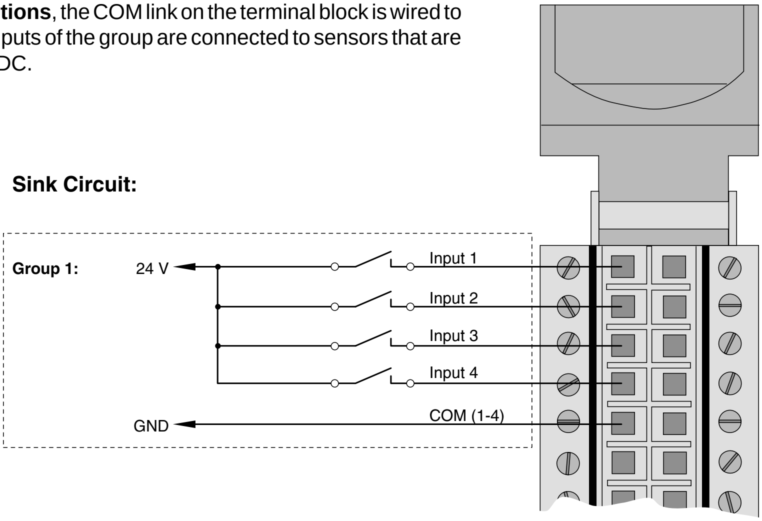
An input filter exists for every input. The input delay is listed in the respective technical data. Any disturbance pulses which are shorter than the input delay are suppressed by the input filter.



7.1.3 Sink/Source Wiring

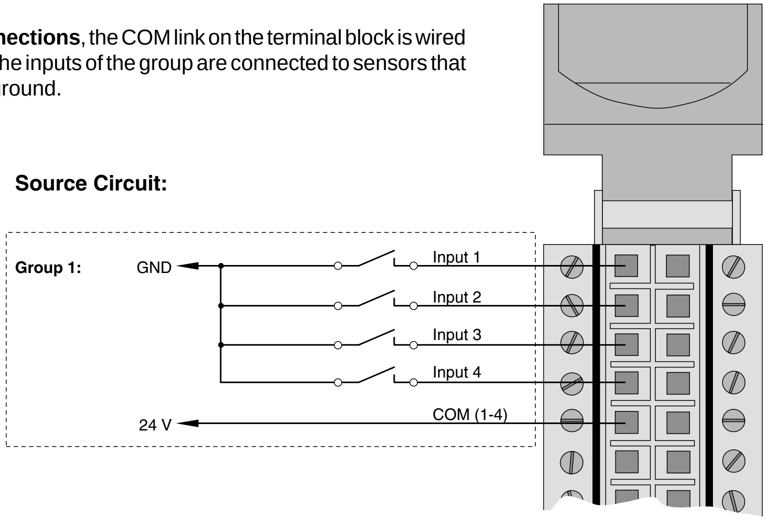
All digital input modules in the B&R 2010 system (**excluding DI825**) can be wired as either sink or source connections. The different groups on a module can be wired individually as Sink or Source:

- For **Sink connections**, the COM link on the terminal block is wired to ground and the inputs of the group are connected to sensors that are switched to 24 VDC.



- For **Source connections**, the COM link on the terminal block is wired to +24 VDC and the inputs of the group are connected to sensors that are switched to ground.

Source Circuit:



7.1.4 Programming

The digital inputs are accessed directly in the application program using a variable name. The relationship between the input channel on a certain module and the variable name is defined in the variable declaration. The declaration is carried out identically for every programming language.

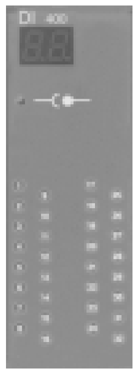
7.2 DI400

7.2.1 Technical Data

Module ID	DI400
Model Number	2DI400.6
Description	2010 Digital Input Module, 32 inputs 24 VDC, 10 msec, Sink/Source, 8 electrically isolated input groups , 8 Change-of-State inputs, 4 counter inputs, 100 kHz, gate or period measurement, order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$01
Base plate Module	BP200, BP201, BP210
Number of Modules per System	1
Number of Inputs Total in 8 Groups of	 32 4
Electrical Isolation Input - PCC Group - Group Input - Input (same group)	 Yes (optocoupler) Yes (optocoupler) No
Wiring Sink Source	Sink or source GND to COM 24 VDC to COM
Input Voltage Nominal Maximum	 24 VDC 30 VDC
Input Resistance	Approx. 4 kΩ

Module ID	DI400
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V
Switching Delay Typ. Max.	 10 msec 12 msec
Input Current at Nominal Voltage	Approx. 6 mA
Maximum Peak Voltage	500 V for 50 µsec max. every 100 msec
CSI Inputs	
Amount	8
Delay	5 µsec
Interrupt Trigger	Change-of-state
Counter Inputs	
Amount	4
Input Frequency	Max. 100 kHz
Resolution	16 bit
Used for	Event counter, gate / period measurement
Power Consumption	Max. 6 W
Dimensions (H, W, D) [mm]	285, 40, 185

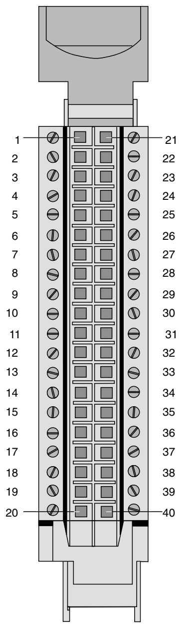
7.2.2 Status LEDs



—(●— Displays the status of the terminal block, i.e. if this LED is lit, either no terminal block is connected to the module or the terminal block is not properly connected.

1 ... **32** These Status LEDs indicate the logical state of the respective input. The LED is lit, independent of the type of connection (Sink or Source), if the input is log. 1, i.e. if current is flowing through the optocoupler.

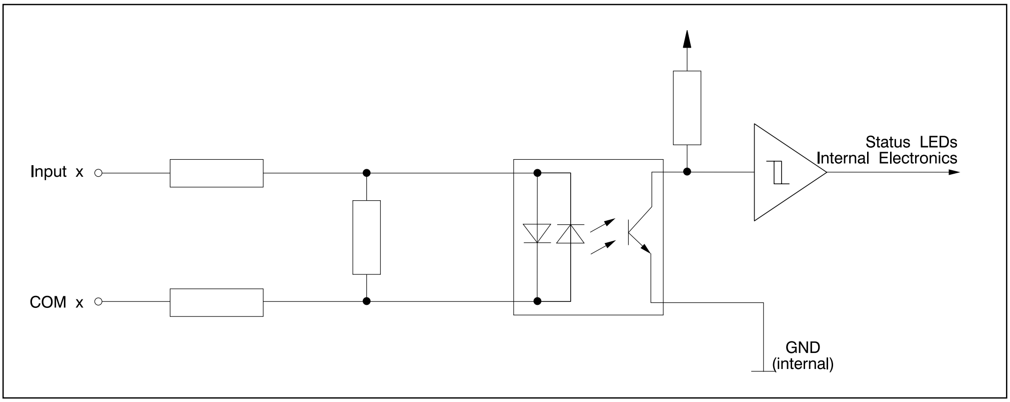
7.2.3 Terminal Assignments



TB140

Termination	Name				
1	Input 1	Change-of-State Input	CSI 1	Group 1
2	Input 2	Change-of-State Input	CSI 2	
3	Input 3	Change-of-State Input	CSI 3	
4	Input 4	Change-of-State Input	CSI 4	
5	COM (1-4)			
6	Input 5	Change-of-State Input	CSI 5	Group 2
7	Input 6	Change-of-State Input	CSI 6	
8	Input 7	Change-of-State Input	CSI 7	
9	Input 8	Change-of-State Input	CSI 8	
10	COM (5-8)			
11	Input 9	Counter 1 / Gate 1 / Period 1	16 Bit	Group 3
12	Input 10			
13	Input 11	Counter 2 / Gate 2 / Period 2	16 Bit	
14	Input 12			
15	COM (9-12)			
16	Input 13	Counter 3 / Gate 3 / Period 3	16 Bit	Group 4
17	Input 14			
18	Input 15	Counter 4 / Gate 4 / Period 4	16 Bit	
19	Input 16			
20	COM (13-16)			
21	Input 17			Group 5
22	Input 18			
23	Input 19			
24	Input 20			
25	COM (17-20)			
26	Input 21			Group 6
27	Input 22			
28	Input 23			
29	Input 24			
30	COM (21-24)			
31	Input 25			Group 7
32	Input 26			
33	Input 27			
34	Input 28			
35	COM (25-28)			
36	Input 29			Group 8
37	Input 30			
38	Input 31			
39	Input 32			
40	COM (29-32)			

7.2.4 Input Circuit



7.2.5 Special Functions

Inputs 1 to 16 are special function inputs:

Inputs	Function
Input 1 - 8	8 Change-of-State Inputs (CSI 1 ... CSI 8)
Input 9 / 10	Counter 1 / Gate 1
Input 11 / 12	Counter 2 / Gate 2
Input 13 / 14	Counter 3 / Gate 3
Input 15 / 16	Counter 4 / Gate 4

7.2.6 Change-of-State Inputs

Inputs 1 to 8 can be selectively enabled for interrupt generation. If the state of a defined (enabled) input changes, an interrupt (IRQ) is created in the CPU and a respective IRQ task is started.
The normal input function is not influenced by active CSI inputs. Each input can be read normally regardless of if the input is enabled as CSI input or not.

7.2.7 Counter (16 Bit)

The user is provided 4 with independent 16 bit counters using the input pairs 9/10, 11/12, 13/14 and 15/16. The counters can be reset at any time by the application program to provide a defined start-point (reference value). Overflows are not registered.

Each counter can be configured individually for:

- Event Counting
- Gate Time Measurement
- Period Measurement

For the gate time and period measurement, an input signal (gate input) is either measured with an internal or external frequency. The external frequency is connected on the counter input. When using an internal frequency, you can select between 1 MHz and 4 MHz.

Each input can be read as a normal digital input regardless of if it is being used as a counter or gate input (10 msec input delay).

7.2.8 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Read digital inputs individually (channel x)	tc_global	BIT	1	Digit. In	1 ... 32
Read digital inputs I01 - I08 Bit 0 ... I01 Bit 7 ... I08	tc_global	BYTE	1	Transp. In	0
Read digital inputs I09 - I16 Bit 0 ... I09 Bit 7 ... I16	tc_global	BYTE	1	Transp. In	1
Read digital inputs I17 - I24 Bit 0 ... I17 Bit 7 ... I24	tc_global	BYTE	1	Transp. In	2
Read digital inputs I25 - I32 Bit 0 ... I25 Bit 7 ... I32	tc_global	BYTE	1	Transp. In	3
Read fast CSI INPUTS I01 - I08 (for SW-compare) In order to determine which input triggered the interrupt, the compare with the fast CSI inputs must be made in the interrupt task. Then the new state is linked with the old state using EXOR. Bit 0 ... I01 Bit 7 ... I08	tc_global	BYTE	1	Transp. In	4
Read information byte "Interrupt Triggerer" The information byte indicates which input triggered the interrupt. In order to prevent a interrupt from being when several interrupts occur, the compare with the fast CSI inputs must be made in the interrupt task. Bit 0 ... I01: 0 - Interrupt not triggered, 1 - Interrupt triggered Bit 7 ... I08: 0 - Interrupt not triggered, 1 - Interrupt triggered	tc_global	BYTE	1	Transp. In	6
Read state of counter 1 (pulse, gate or period duration measurement)	tc_global	INT16	1	Transp. In	8
Read state of counter 2 (pulse, gate or period duration measurement)	tc_global	INT16	1	Transp. In	10
Read state of counter 3 (pulse, gate or period duration measurement)	tc_global	INT16	1	Transp. In	12
Read state of counter 4 (pulse, gate or period duration measurement)	tc_global	INT16	1	Transp. In	14
Read terminal status Bit 0 = 1: terminal not inserted Bit 0 = 0: terminal inserted on module	tc_global	BYTE	1	Status In	0
Interrupt enable - Enable Bit 7 (e.g. with 128)	tc_global	BYTE	1	Status Out	0
Enable the individual CSI inputs, each bit corresponds to an input Bit 0 = I01: 0 - disabled, 1 - enabled Bit 7 = I08: 0 - disabled, 1 - enabled	tc_global	BYTE	1	Status Out	1
Reset counter 1 with bit 7 = 0	tc_global	BYTE	1	Status Out	8
Configure counter 1 (see section "Register Configuration")	tc_global	BYTE	1	Status Out	9
Reset counter 2 with bit 7 = 0	tc_global	BYTE	1	Status Out	10
Configure counter 2 (see section "Register Configuration")	tc_global	BYTE	1	Status Out	11
Reset counter 3 with bit 7 = 0	tc_global	BYTE	1	Status Out	12
Configure counter 3 (see section "Register Configuration")	tc_global	BYTE	1	Status Out	13
Reset counter 4 with bit 7 = 0	tc_global	BYTE	1	Status Out	14
Configure counter 4 (see section "Register Configuration")	tc_global	BYTE	1	Status Out	15

Configuration Register

REGISTER WRITTEN	Bit	Description	
	7	0	
	6	0	
	5	FlTor	- Negative ↔ positive on gate input
	4	FlCount	- Negative edge on counter input
	3	Gate	- Gate measurement
	2	Peri	- Period measurement
	1	Ext	- External frequency
	0	1 MHz	- Internal 1 MHz

0 0
7 0

FlTor 0 .... Positive↔negative edge on gate input
1 .... Negative↔positive edge on gate input

FlCount 0 .... Positive edge on counter input
1 .... Negative edge on counter input

Gate 0 .... Pulse measurement
1 .... Gate measurement

Peri 0 .... Gate measurement
1 .... Period measurement

Ext 0 .... Internal frequency
1 .... External frequency

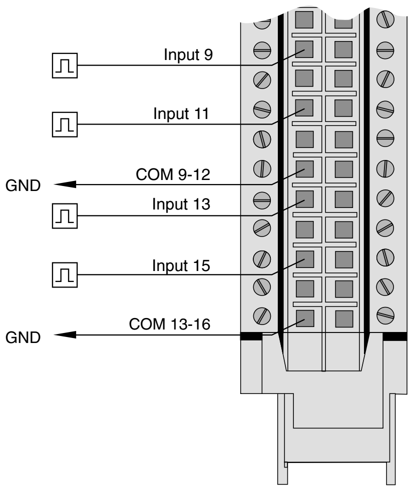
1 MHz 0 .... Internal 4 MHz
1 .... Internal 1 MHz

7.2.9 Connection Example for Pulse Measurement

Four 16 Bit counter, positive edge (default)

Configuration register: $00

Pin Assignments:



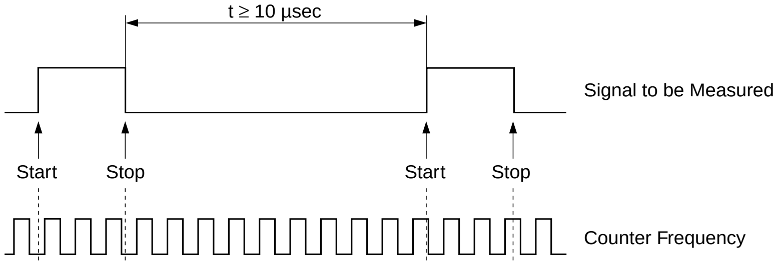
7.2.10 Gate Measurement

A signal connected to channel 10, 12, 14 or 16 can be measured using gate measurement. The pause between two gate measurements must be ≥10 µsec.
A internal and an external counter frequency can be selected for the measurement. The setting is made with the configuration register.

- ❍ Internal counter frequency (1 MHz or 4 MHz)
- ❍ External counter frequency (Rev. ≤36.00 max. 15 kHz / Rev. ≥46.00 max. 100 kHz)

The external counter frequency is connected to channel 9 (for gate measurement on channel 10), channel 11 (measurement on channel 12), 13 (measurement on channel 14) or 15 (measurement on channel 16). The external frequency can be selected separately for all channels.

Principles of Gate Measurement



Pulse counting is started with the rising edge of the gate and stopped with the falling edge. At the falling edge, the counter value is placed in a buffer register. At the next rising edge, the counter begins to run again. During gate time measurement, the last counter value saved (gate time) can be read by the application program. The value in the buffer register is only updated at the end of the current measurement (falling edge).

The DI400 offers another possibility for gate measurement. Pulse counting is started at the negative edge and stopped at the positive edge for this type of measurement. The setting is made with configuration register.

Connection Example for Gate Time Measurement

Gate time measurement on all four channels (positive to negative edge).

An external frequency is used for the measurement:

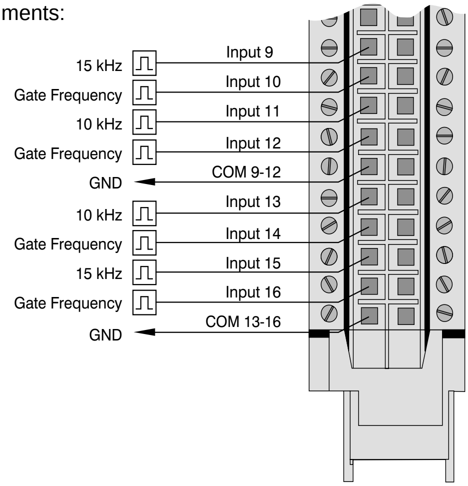
Channel 9 and 15: 15 kHz
Channel 11 and 13: 10 kHz

Configuration Register:

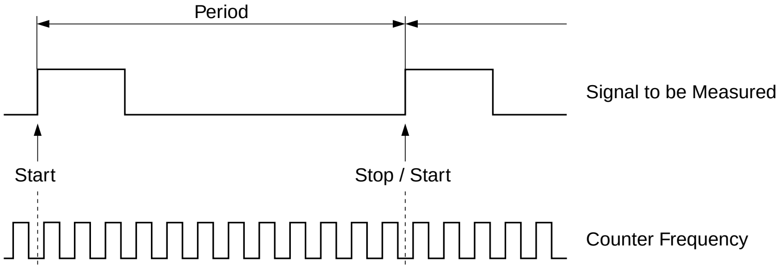
0	0	0	0	1	0	1	0
7							0

= $0A

Terminal assignments:



7.2.11 Period Measurement



Pulse counting is started with the rising edge on the input and stopped with the next rising edge. The counter value is placed in a buffer register. The counter starts to run again with the same rising edge.
During a period measurement, the last counter value saved (period) can be read by the application program. The value in the buffer register is only updated at the end of the current measurement.

Connection Example for Period Measurement

Gate time measurement on all four channels.

An external frequency is used for the measurement:

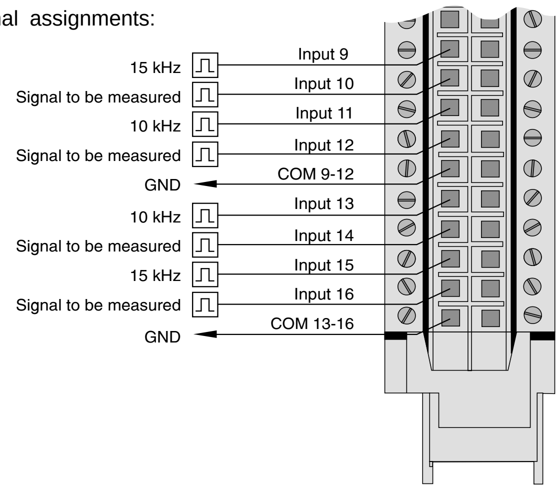
Channel 9 and 15: 15 kHz
Channel 11 and 13: 10 kHz

Configuration Register:

0	0	0	0	0	1	1	0
7							0

= $06

Terminal assignments:



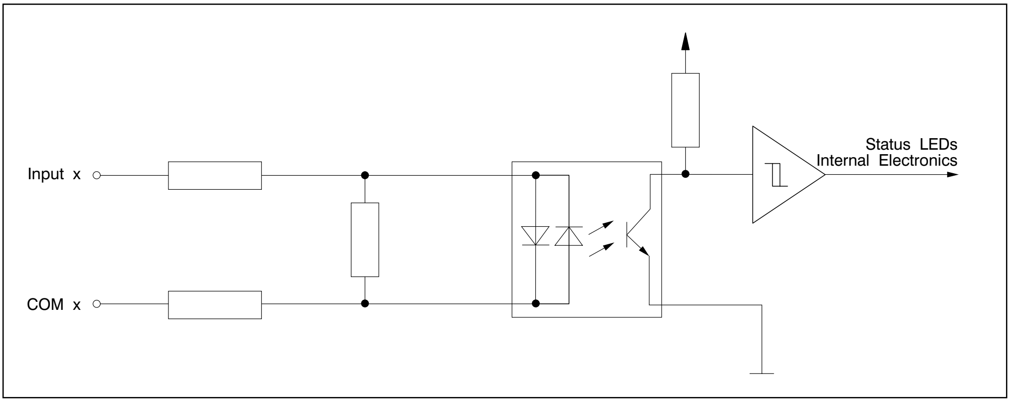
7.3 DI425 / DI426

7.3.1 Technical Data

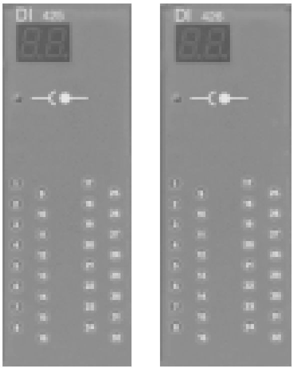
Module ID	DI425	DI426
Model Number	2DI425.6	2DI426.6
Description	2010 Digital Input Module, 32 inputs 24 VDC, 10 msec, sink/source, 8 electrically isolated input groups, Order terminal blocks separately!	2010 Digital Input Module, 32 inputs 24 VDC, 1 msec, sink/source, 8 electrically isolated input groups, Order terminal blocks separately!
C-UL-US Listed	Yes	Yes
B&R ID Code	$01	$03
Base Plate Module	BP200, BP201, BP210	
Number of Inputs Total in 8 Groups of	 32 4	
Electrical Isolation Input - PCC Group - Group Input - Input (same group)	 Yes (optocoupler) Yes (optocoupler) No	
Wiring	Sink or source	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Input Resistance	4 kΩ	
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V	

Module ID	DI425	DI426
Switching Delay Typ. Max.	 10 msec 12 msec	 1 msec 1.2 msec
Input Current at Nominal Voltage	Approx. 6 mA	
Maximum Peak Voltage	500 V for 50 µsec max. every 100 msec	
Power Consumption	Max. 6 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

7.3.2 Input Circuit



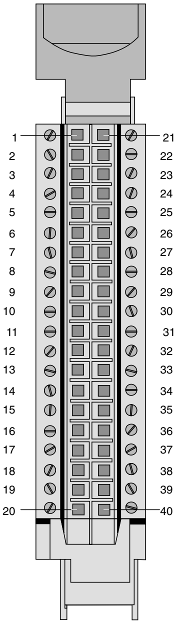
7.3.3 Status LEDs



—< ●— Displays the status of the terminal block, i.e. if this LED is lit, either no terminal block is connected to the module or the terminal block is not properly connected.

1 ... **32** These Status LEDs indicate the logical state of the respective input. The LED is lit, independent of the type of connection (Sink or Source), if the input is log. 1, i.e. if current is flowing through the optocoupler.

7.3.4 Terminal Assignments



TB140

Termination	Description		Termination	Description	
1	Input 1	Group 1	21	Input 17	Group 5
2	Input 2		22	Input 18	
3	Input 3		23	Input 19	
4	Input 4		24	Input 20	
5	COM (1-4)		25	COM (17-20)	
6	Input 5	Group 2	26	Input 21	Group 6
7	Input 6		27	Input 22	
8	Input 7		28	Input 23	
9	Input 8		29	Input 24	
10	COM (5-8)		30	COM (21-24)	
11	Input 9	Group 3	31	Input 25	Group 7
12	Input 10		32	Input 26	
13	Input 11		33	Input 27	
14	Input 12		34	Input 28	
15	COM (9-12)		35	COM (25-28)	
16	Input 13	Group 4	36	Input 29	Group 8
17	Input 14		37	Input 30	
18	Input 15		38	Input 31	
19	Input 16		39	Input 32	
20	COM (13-16)		40	COM (29-32)	

7.3.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data type	Length	Module type	Channel
Read single digital input (channel x)	tc_global	BIT	1	Digit. In	1 ... 32
Read terminal block status Bit 0 = 1 .... Terminal not connected Bit 0 = 0 .... Terminal connected with module	tc_global	BYTE	1	Status In	0

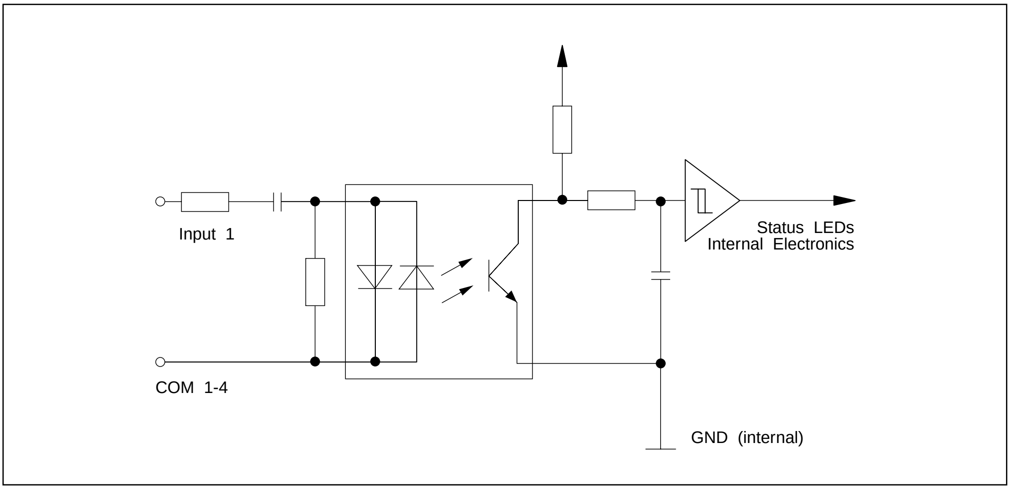
7.4 DI725

7.4.1 Technical Data

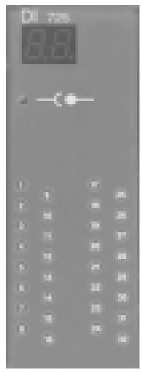
Module ID	DI725
General	
Model Number	2DI725.6
Description	2010 Digital Input Module, 32 inputs 120/230 VAC, 50 msec, 8 electrically isolated input groups, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$26
Base Plate Module	BP200, BP201, BP210
Input Circuit	see "Input Circuit"
Static Characteristics	
Module Type	B&R 2010 I/O module - single width
Number of Inputs	32
Maximum Peak Voltage	264 VAC
Rated Voltage	120 / 230 VAC
Rated Frequency	50 / 60 Hz
Limit Values 0-Signal UL 0-Signal IL 1-Signal UH 1-Signal IH	 Max. 40 VAC Max. 15 mA Min. 79 VAC Min. 2 mA

Module ID	DI725
Delay 0 to 1	max. 50 msec
Delay 1 to 0	max. 50 msec
Power Consumption Internal External	 max. 4 W max. 7 W
Additional Characteristics	
Status Display Terminal Status Inputs	 1 red LED 1 green LED per channel
Operating Characteristics	
Effects if Inputs are Connected Incorrectly	No effects on the module
Isolation Voltage under Normal Operating Conditions between Channel and Bus Other Channel	 2500 VAC 500 VAC
Tapping Point and Binary Status of the Image Register	PCC logic
Effects of Removing/Inserting The Input Module under Power	No effects on the module
Additional External Load when Switching Inputs and Outputs Together, if Required	See specification of the respective output module
Signal Evaluation	AC voltage runs through an RC combination to the optocoupler. Evaluation takes place using a comparator with filter. Further signal processing in digital part.
Typical Example for External Connections	COM connected to neutral and input to switched phase
Different Circuits Possible	Yes (but not different phases)
Mechanical Characteristics	
Dimensions	B&R 2010 single width
Terminal Assignments	see "Terminal Assignments"

7.4.2 Input Circuit



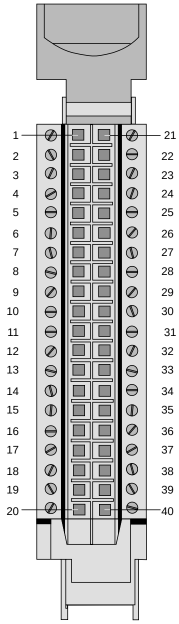
7.4.3 Status LEDs



—< ●— Displays the status of the terminal block, i.e. if this LED is lit, either no terminal block is connected to the module or the terminal block is not properly connected.

1 ... **32** These status LEDs indicate the logical state of the respective input. The LED is lit when the input is log. 1, i.e current is flowing through the optocoupler.

7.4.4 Terminal Assignments



TB140

Termination	Description		Termination	Description	
1	Input 1	Group 1	21	Input 17	Group 5
2	Input 2		22	Input 18	
3	Input 3		23	Input 19	
4	Input 4		24	Input 20	
5	COM (1-4)		25	COM (17-20)	
6	Input 5	Group 2	26	Input 21	Group 6
7	Input 6		27	Input 22	
8	Input 7		28	Input 23	
9	Input 8		29	Input 24	
10	COM (5-8)		30	COM (21-24)	
11	Input 9	Group 3	31	Input 25	Group 7
12	Input 10		32	Input 26	
13	Input 11		33	Input 27	
14	Input 12		34	Input 28	
15	COM (9-12)		35	COM (25-28)	
16	Input 13	Group 4	36	Input 29	Group 8
17	Input 14		37	Input 30	
18	Input 15		38	Input 31	
19	Input 16		39	Input 32	
20	COM (13-16)		40	COM (29-32)	

7.4.5 Variable Declarations

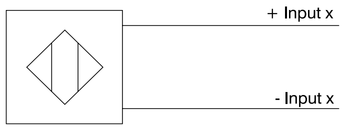
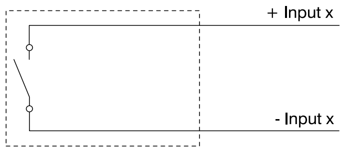
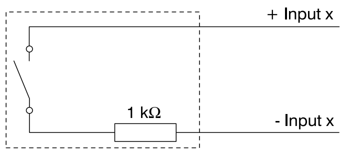
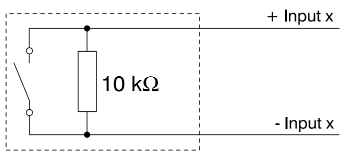
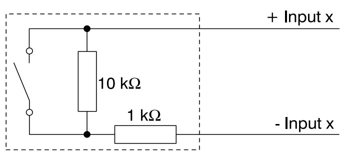
Function	Variable Declaration				
	Scope	Data type	Length	Module type	Channel
Read a single digital input (channel x)	tc_global	BIT	1	Digital In.	1 ... 32
Read terminal block status Bit 0 = 1 .... No terminal block connected Bit 0 = 0 .... Terminal block connected	tc_global	BYTE	1	Status In.	0

7.5 DI825

7.5.1 General Information

The DI825 module is used to convert digital signals from the levels that can cause explosions to levels that cannot cause explosions. In order to meet the requirements for such a task, the input circuit for the DI825 module has [EEx ia] IIC ignition protection.

<u>Examples for possible signal encoders:</u>

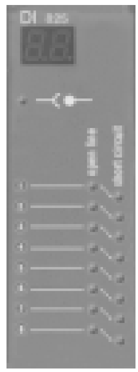
Proximity Switch	
Switch according to DIN 19234 (Namur)	
Mechanical Contacts	
Without open circuit and without short circuit recognition	
Without open circuit and with short circuit recognition	
With open circuit and without short circuit recognition	
With open circuit and with short circuit recognition	

7.5.2 Technical Data

Module ID	DI825
General	
Model Number	2DI825.6
Description	2010 Digital Input Module, 8 Namur inputs, Ex(i),12 V, 12 mA, electrically isolated and intrinsically safe, Order terminal block separately!
C-UL-US Listed	in preparation
B&R ID Code	$1F
Base Plate Module	BP200, BP201, BP210
Static Characteristics	
Module Type	B&R 2010 I/O module single width
Number of Inputs	8
No-Load Voltage	8.05 V ±5%
Maximum Values per Input Circuit [1)] Max. Voltage Max. Current Max. Power	 12 V 12 mA 36 mW
Maximum Values for Ignition protection [EEx ia] IIC Maximum External Capacitance Maximum External Inductance	 0.5 µF 2 mH
Internal Resistance	Approx. 1 kΩ
Open Line Recognition Switching Range Hysteresis	 50 µA to 350 µA Typ. 0.15 mA

Module ID	DI825
Short Circuit Recognition Switching Range Hysteresis	 100Ω to 360Ω Typ. 100Ω
Switching Threshold Switching Range Hysteresis	 1.2 mA to 2.1 mA Typ. 0.5 mA
Delay 0 to 1	Max. 100 µsec
Delay 1 to 0	Max. 100 µsec
Power Consumption	Max. 11 W
Operating Characteristics	
Electrical Isolation Input - PCC Input - Input	 Yes / max. peak value of nominal voltage: 375 V Yes / max. peak value of nominal voltage: 375 V
Intrinsic Safety	Yes
Mechanical Characteristics	
Dimensions (H, W, D) [mm]	285, 40, 185
Terminal Assignments	see section "Terminal Assignments"

7.5.3 Status LEDs



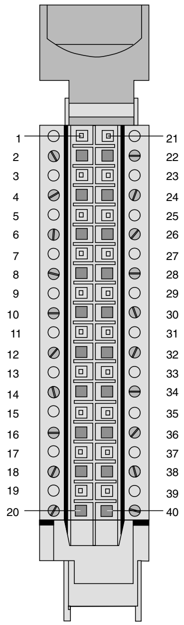
—‹ ●— This LED shows the terminal status. That means, if this LED is lit, a terminal block is not installed or is not correctly installed on the module.

1 ... **8** The Status LEDs show the logical status of the respective input.

open line Open line recognition for the respective input.
LED lit .... open line
LED not lit .... no open line

short circuit Short circuit recognition for the respective input.
LED lit .... short circuit
LED not lit .... no short circuit

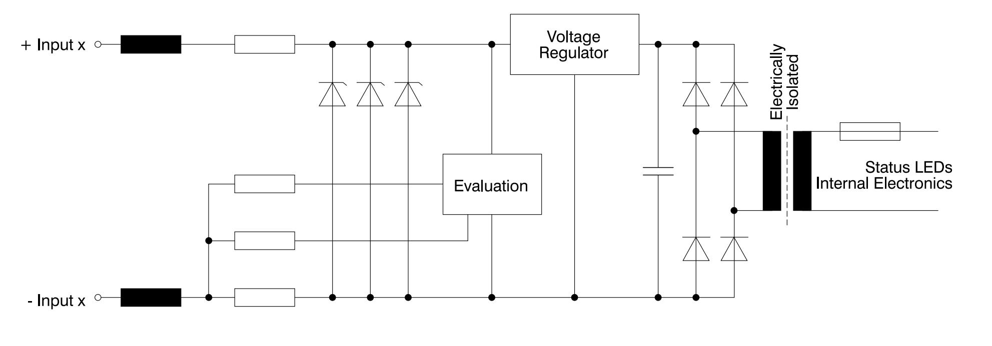
7.5.4 Terminal Assignments



TB120

Terminal	Description	Terminal	Description
1		21	
2	---	22	---
3		23	
4	---	24	---
5		25	
6	- Input 1	26	+ Input 1
7		27	
8	- Input 2	28	+ Input 2
9		29	
10	- Input 3	30	+ Input 3
11		31	
12	- Input 4	32	+ Input 4
13		33	
14	- Input 5	34	+ Input 5
15		35	
16	- Input 6	36	+ Input 6
17		37	
18	- Input 7	38	+ Input 7
19		39	
20	- Input 8	40	+ Input 8

7.5.5 Input Circuit



7.5.6 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Read single digital input (channel x)	tc_global	BIT	1	Digit. In	1 ... 8
Read terminal status Bit 0 = 1: No terminal block installed Bit 0 = 0: Terminal block installed	tc_global	BYTE	1	Status In	0
Read open line register	tc_global	BYTE	1	Status In	2
Read digital inputs I17 - I24	tc_global	BYTE	1	Status In	3

Open Line Register (read)

No ... no open line
Yes ... open line

Bit	Status	Description
0	0	No
	1	Yes
1	0	No
	1	Yes
2	0	No
	1	Yes
3	0	No
	1	Yes
4	0	No
	1	Yes
5	0	No
	1	Yes
6	0	No
	1	Yes
7	0	No
	1	Yes

Short Circuit Register (read)

No ... no short circuit
Yes ... short circuit

Bit	Status	Description
0	0	No
	1	Yes
1	0	No
	1	Yes
2	0	No
	1	Yes
3	0	No
	1	Yes
4	0	No
	1	Yes
5	0	No
	1	Yes
6	0	No
	1	Yes
7	0	No
	1	Yes

7.5.7 Standards

In addition to the standards met by all modules in the B&R SYSTEM 2000 control generation, the DI825 module conforms to the European standard for "Electrical apparatus for potentially explosive atmospheres":

- **IEC 50014: 1977 + A1 ... A5 (VDE 0170/0171 Part 1 superseded)**
  Electrical apparatus for potentially explosive atmospheres, General requirements
- **IEC 50020: 1977 + A1 ... A2 (VDE 0170/0171 Part 1 superseded)**
  Electrical apparatus for potentially explosive atmospheres, Intrinsic safety 'i'

8 DIGITAL OUTPUT MODULES

8.1 GENERAL INFORMATION

Digital output modules are used for controlling external loads (relays, motors, magnetic valves, etc.). The status of the digital outputs is indicated by means of status LEDs.

The most important characteristics are:

- ❍ Number of outputs
- ❍ Type (relay, transistor, triac)
- ❍ Switching voltage
- ❍ Continuous current

8.1.1 Overview

Module	Number of Outputs	Type	Nominal Switching Voltage	Continuous Current
DO428	32	Transistor	24 VDC	0.5 A
DO430	32	Transistor	24 VDC	2 A
DO600	32	Relay	24 VDC / 120 VAC	2 A
DO700	16	Relay	24 VDC / 230 VAC	2 A
DO710	8 Change-over 8 Normally open	Relay	30 VDC / 240 VAC	4 A

8.1.2 Protective Circuit

The transistor output modules DO428 and DO430 are equipped with overload protection and an internal protection circuit against overload peaks or reversed polarity. These modules make fast switching of inductive loads with a negative voltage possible, and external inverse diodes are not needed.

8.1.3 Programming

Digital outputs are addressed directly in the application program by their variable names. The relationship between output channels of certain modules and the variable names is established in the variable declaration. The declaration is the made the same for all programming languages, with the help of a table editor.

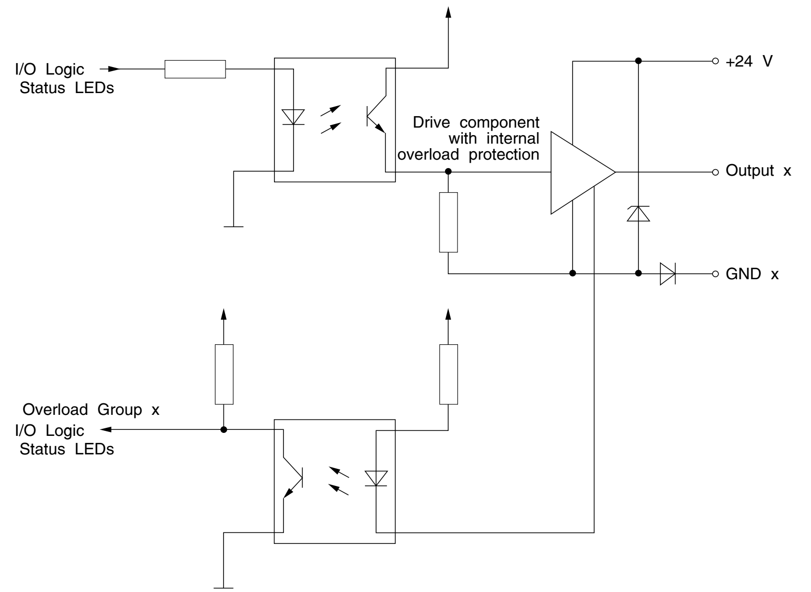
8.2 DO428

8.2.1 Technical Data

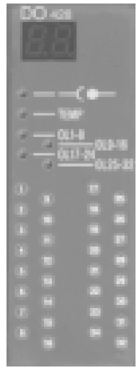
Module ID	DO428
Model Number	2DO428.6
Description	2010 Digital Output Module, 32 transistor outputs 24 VDC, 0.5 A, 4 electrically isolated output groups, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$1D
Base Plate Module	BP200, BP201, BP210
Number of Outputs Total in 4 Groups of	 32 8
Type Transistor	
Electrical Isolation Output - PCC Group - Group Output - Output	 Yes Yes No
Switching Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current per Output per Group Module	 Max. 0.5 A Max. 4 A Max. 16 A
Leakage Current when Switched Off	0.3 mA

Module ID	DO428
Switching Delay log. 0 - log. 1 log. 1 - log. 0	 Typ. 5 µsec / max. 110 µsec Typ. 60 µsec / max. 100 µsec
Switching Frequency (resistive load)	Max. 500 Hz
Overload Protection	Yes
Start after Overload Cutoff	Automatic after approx. 5 sec
Short Circuit Current	0.75 to 1.5 A
Protective Circuit Internal External	 Against peak over voltage to 55 V (VDE 160) Against reverse polarity of the 24 V supply on the module only if required (Surge)
Reverse Voltage for Turning Off Inductive Loads	45 to 55 V
Power Consumption Internal Terminal Side at 24 V	 Max. 5 W Max. 2 W per group
Dimensions (H, W, D) [mm]	285, 40, 185

8.2.2 Output Circuit



8.2.3 Status LEDs



	Indicates the status of the terminal block, i.e. if this LED is lit the terminal block is either not connected to the module or is not connected properly.
TEMP	Indicates that all outputs have been switched off because of excessive temperature in the inside of the module. This function protects the module from thermal damage. After the module has cooled for approx. 10 sec, normal operation continues.
OL x-y	Overload: These LEDs indicate that the overload or the short circuit protection circuit has been activated for the respective LED group. If for example the LED OL 1-8 is lit, one of the outputs 1 to 8 has been switched off (for more information refer to section “Overload Protection”).
1 ... **32**	LEDs 1 to 32 indicate the logical status of the respective output.

8.2.4 Loads Free Switching

By removing the terminal block, the terminal block contact of the output module is turned off. This prevents any wear on the contacts because the terminal block is always inserted or removed without power. The logical state is retained when the terminal block is removed, i.e. immediately after re-inserting the terminal block, the outputs can continue from where they left off.

8.2.5 Overload Protection

Overload protection is activated in the following cases:

- ❍ The junction temperature for the transistors exceeds the limit (typ. 150 °C, min. 135 °C, max. 175 °C). Causes: short circuit, overload or excessive environmental temperature.
- ❍ The 24 V supply voltage (terminal side) is less than typ. 13 V (min. 10 V, max. 14.5 V)

The affected output is switched off until ...

... the junction temperature is again within the allowed limits (Hysteresis typ. 20 °C). The time before it is switched on again is normally within seconds.

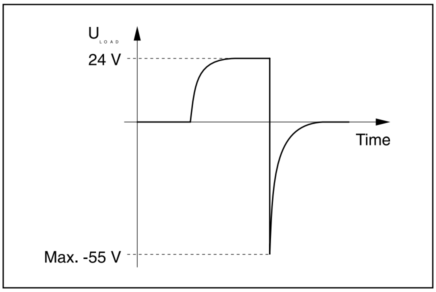
... the supply voltage is in the valid range (typ. > 14.5 V).

... the terminal block is connected properly.

8.2.6 Switching Inductive Loads

The transistor enables the fast and safe switching of inductive loads. It is not necessary to use an inverse diode on the inductive load. Note however that the maximum switching frequency is inductively limited by the fixed reverse voltage of 45 to 55 V.

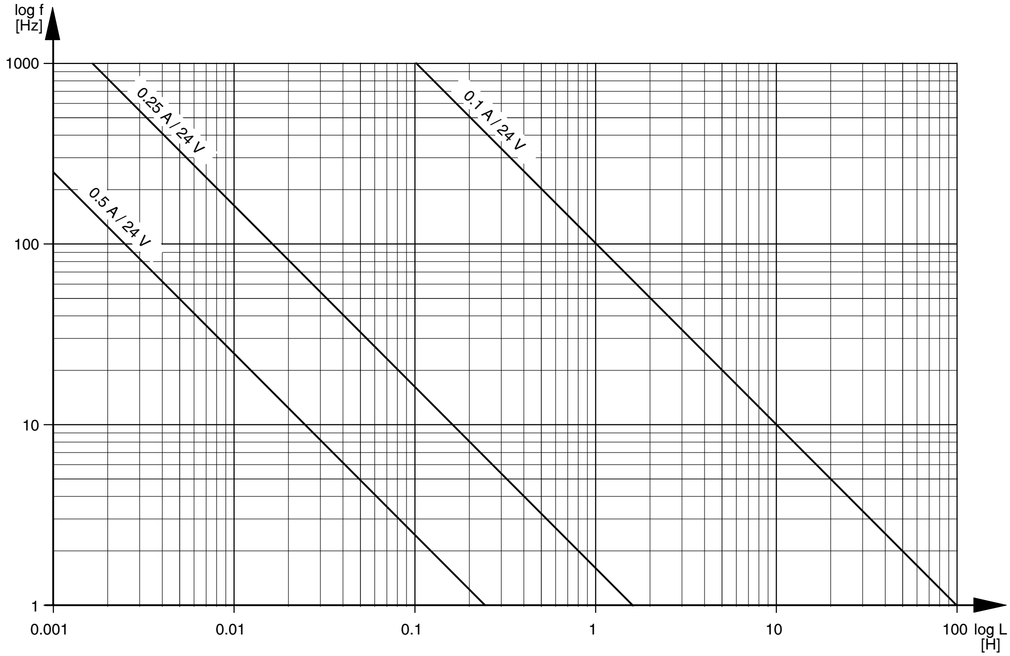
Reverse voltage: The reverse voltage is a negative voltage on the switching element (e.g. valve). If the switching element does not allow operation with a negative voltage, an inverse diode must be installed externally in order to limit the voltage to approximately -0.6 V.



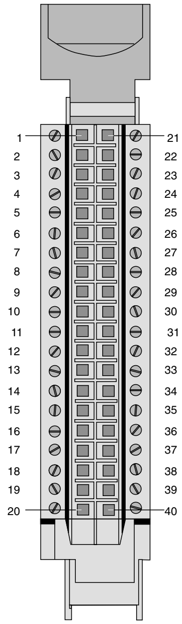
Schematic Diagram of Reverse Voltage

The maximum switching frequency is reduced with increasing inductance. An inductance of 0.5 H can be switched without any problems with 0.5 Hz at 24 V / 0.5 A and 60 °C environmental temperature.

The maximum switching frequency for a given value for inductance can be calculated from the following graph:



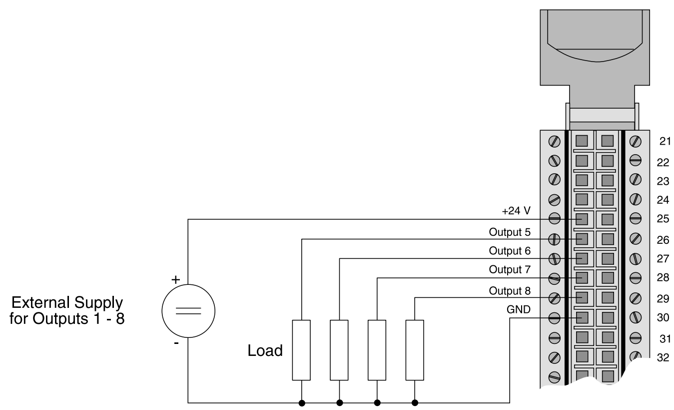
8.2.7 Terminal Assignments



TB140

Terminal	Description		Terminal	Description	
1	Output 1	Group 1	21	Output 17	Group 3
2	Output 2		22	Output 18	
3	Output 3		23	Output 19	
4	Output 4		24	Output 20	
5	+24 V (1-8)		25	+24 V (17-24)	
6	Output 5		26	Output 21	
7	Output 6		27	Output 22	
8	Output 7		28	Output 23	
9	Output 8		29	Output 24	
10	GND (1-8)		30	GND (17-24)	
11	Output 9	Group 2	31	Output 25	Group 4
12	Output 10		32	Output 26	
13	Output 11		33	Output 27	
14	Output 12		34	Output 28	
15	+24 V (9-16)		35	+24 V (25-32)	
16	Output 13		36	Output 29	
17	Output 14		37	Output 30	
18	Output 15		38	Output 31	
19	Output 16		39	Output 32	
20	GND (9-16)		40	GND (25-32)	

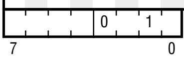
Connection Example



8.2.8 Variable Declaration

Function	Variable Declaration				
	Scope	**Data Type**	**Length**	**Module Type**	**Channel**
Single Digital Output (Channel x)	tc_global	BIT	1	Digital Out	1 ... 32
Read Status Register	tc_global	BYTE	1	Status In	0

STATUS REGISTER	Bit	Description	0	1
	7	Overload channel 25 to 32	no	yes
	6	Overload channel 17 to 24	no	yes
	5	Overload channel 9 to 16	no	yes
	4	Overload channel 1 to 8	no	yes
	3	0		
	2	Max. temperature exceeded	no	yes
	1	1		
	0	Terminal status: Terminal block inserted in module	yes	no



8.3 DO430

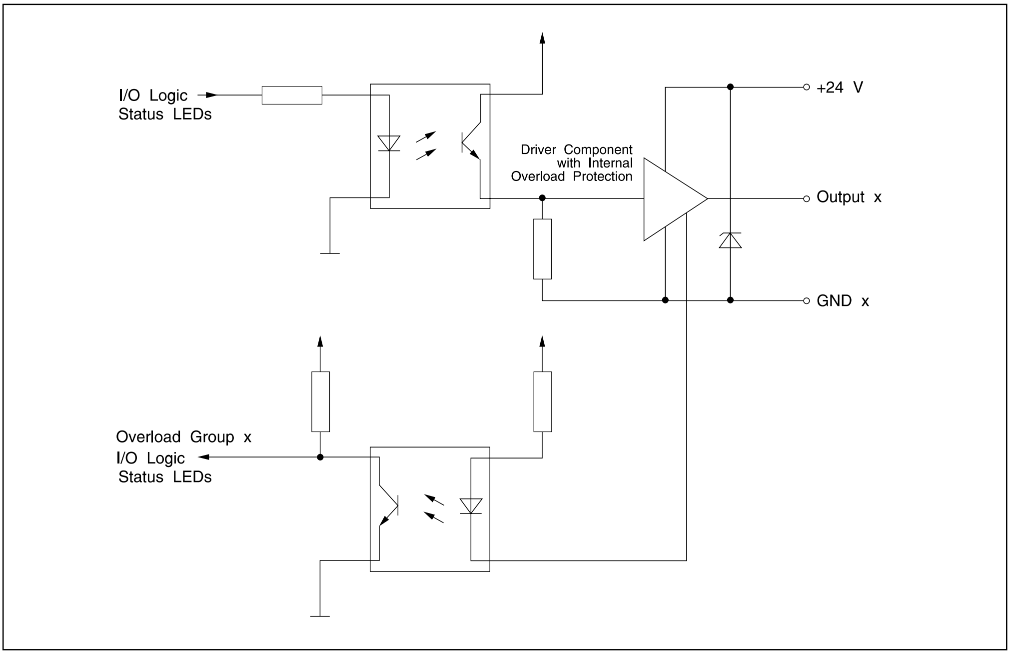
8.3.1 Technical Data

Module ID	DO430
Model Number	2DO430.6
Description	2010 Digital Output Module, 32 transistor outputs 24 VDC, 2 A, 4 electrically isolated output groups, Order terminal blocks separately !
C-UL-US Listed	Yes
B&R ID Code	$20
Base Plate Module	BP200, BP201, BP210
Number of Outputs Total in 4 Groups of	 32 8
Type Transistor	
Electrical Isolation Output - PCC Group - Group Output - Output	 Yes Yes No
Switching Voltage with VDE Pulse Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current per Output per Group Module	 Max. 2 A Max. 12 A (simultaneousness = 75 %) [1)] Max. 48 A
Leakage Current when Switched Off	Max. 1.5 mA

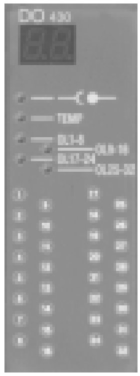
Module ID	DO430
Switching Delay (resistive load) log. 0 - log. 1 log. 1 - log. 0	 Max. 100 µsec Max. 100 µsec
Switching Frequency (resistive load)	Max. 500 Hz
Overload Protection	Yes
Start after Overload Cutoff	Automatic after max. 350 msec
Short Circuit Current	7 A
Protective Circuit Internal External	 Against peak over voltage to 55 V (VDE 160) Against reverse polarity of the 24 V supply on the module only if required (Surge)
Reverse Voltage for Turning Off Inductive Loads	Supply voltage - 70 V
Power Consumption	Max. 2.9 W
Dimensions (H, W, D) [mm]	285, 40, 185

[1] Simultaneousness = 75 %: Maximum 24 of the 32 outputs can be fully loaded at one time.

8.3.2 Output Circuit



8.3.3 Status LEDs



—< ●— Indicates the status of the terminal block, i.e. if this LED is lit the terminal block is either not connected to the module or is not connected properly.

TEMP If the TEMP LED is blinking, the temperature within the module is becoming WARM. If the temperature within the module increases any more, the allowed temperature range "HOT" will be reached after approximately 10 seconds. At this time, in order to avoid any damage in the module, all outputs will be switched off automatically. This is displayed by the LED lighting full time. The LED will be lit until such a time as the temperature decreases to within the allowed range again.

OL x-y Overload: These LEDs indicate that the overload or the short circuit protection circuit has been activated for the respective LED group. If for example the LED OL 1-8 is lit, one of the outputs 1 to 8 has been switched off (for more information refer to section “Overload Protection”).

1 ... 32 LEDs 1 to 32 indicate the logical status of the respective output.

8.3.4 Load Free Switching

By removing the terminal block, the terminal block contact of the output module is turned off. This prevents any wear on the contacts because the terminal block is always inserted or removed without power. The logical state is retained when the terminal block is removed, i.e. immediately after re-inserting the terminal block, the outputs can continue from where they left off.

8.3.5 Overload Protection

The overload protection is activated if the junction temperature of the transistors exceeds the allowed limit values (typ. 170 °C). Causes: Short circuit, overload or the environmental temperature is too high.

The affected output is switched off until ...

... the junction temperature is again within the allowed limits (Hysteresis typ. 5 °C). The time before it is switched on again is normally within seconds.

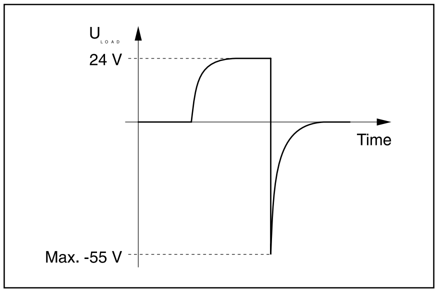
... the output voltage is < 0.5 A.

... the terminal block is connected properly.

8.3.6 Switching Inductive Loads

Transistors ensure fast and secure switching of inductive loads. It is not necessary to use an inverse diode on the inductive load. Note however that the maximum switching frequency is inductively limited by the fixed reverse voltage of 45 to 55 V.

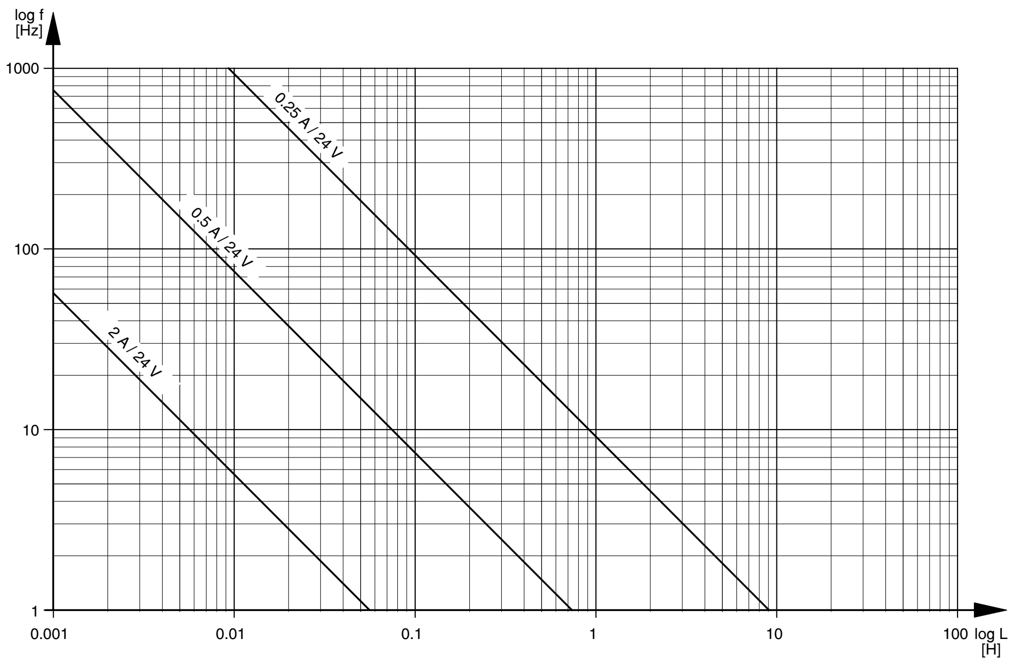
Reverse voltage: The reverse voltage is a negative voltage on the switching element (e.g. valve). If the switching element should not be allowed to operate with another negative voltage, an external inverse diode is to be integrated externally to limit the voltage to approximately -0.6 V .



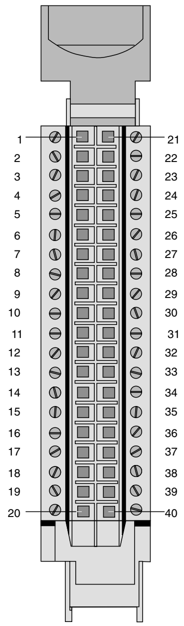
Schematic Diagram of Reverse Voltage

The maximum switching frequency is reduced with increasing inductance. An inductance of 1 H can be switched with 8 Hz without any problems at 24 V / 0.25 A and an environmental temperature of 60 °C.

The following diagram shows the maximum switching frequencies at corresponding inductances



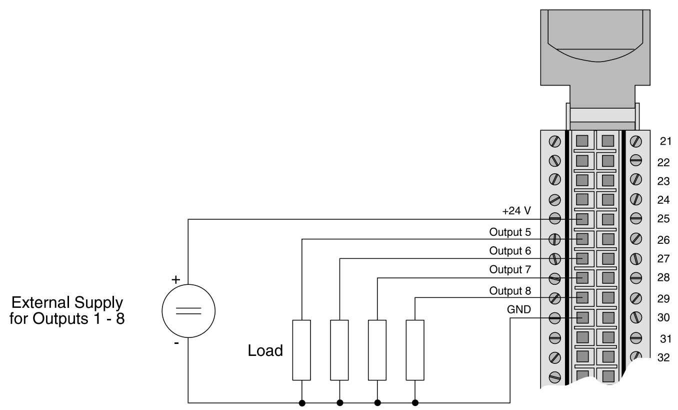
8.3.7 Terminal Assignments



TB140

Terminal	Description		Terminal	Description	
1	Output 1	Group 1	21	Output 17	Group 3
2	Output 2		22	Output 18	
3	Output 3		23	Output 19	
4	Output 4		24	Output 20	
5	+24 V (1-8)		25	+24 V (17-24)	
6	Output 5		26	Output 21	
7	Output 6		27	Output 22	
8	Output 7		28	Output 23	
9	Output 8		29	Output 24	
10	GND (1-8)		30	GND (17-24)	
11	Output 9	Group 2	31	Output 25	Group 4
12	Output 10		32	Output 26	
13	Output 11		33	Output 27	
14	Output 12		34	Output 28	
15	+24 V (9-16)		35	+24 V (25-32)	
16	Output 13		36	Output 29	
17	Output 14		37	Output 30	
18	Output 15		38	Output 31	
19	Output 16		39	Output 32	
20	GND (9-16)		40	GND (25-32)	

Connection Example



8.3.8 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Digital Output (Channel x)	tc_global	BIT	1	Digital Out	1 ... 32
Read Status Register	tc_global	BYTE	1	Status In	0

STATUS REGISTER	Bit	Description	0	1
	7	Overload Channel 25 to 32	No	Yes
	6	Overload Channel 17 to 24	No	Yes
	5	Overload Channel 9 to 16	No	Yes
	4	Overload Channel 1 to 8	No	Yes
	3	Overtemperature (WARM)	No	Yes
	2	Overtemperature (HOT)	No	Yes
	1			
	0	Terminal block status: Terminal block connected	Yes	No

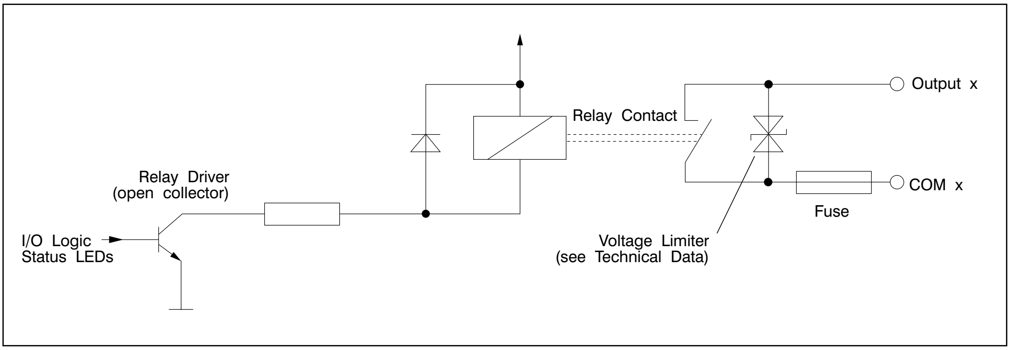
8.4 DO600

8.4.1 Technical Data

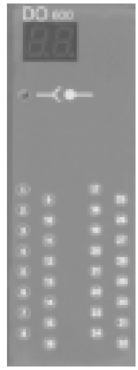
Module ID	DO600
Model Number	2DO600.6
Description	2010 Digital Output Module, 32 relay outputs 120 VAC / 24 VDC, 2 A, 8 electrically isolated output groups, order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$06
Base Plate Module	BP200, BP201, BP210
Number of Outputs Total in 8 Groups of	 32 4
Type	Relay / normally open
Electrical Isolation Output - PCC Group - Group Output - Output	 Yes Yes No
Switching Voltage Nominal Maximum	 120 VAC / 24 VDC 144 VAC / 30 VDC
Continuous Current per Output per Group Module	 Max. 2 A Max. 8 A Max. 32 A
Switching Power Minimum Maximum	 1 mA / 5 VDC 750 VA / 90 W

Module ID	DO600
Switching Delay	Approx. 10 msec
Short Circuit Protection	Fuse 10 A (at least 8 A) slow-blow per group
External Protective Circuit	Generally required
Voltage Limits on Relay Contacts	400 V_{ss}
Contact Resistance at Maximum Load	30 mΩ
Switching Cycle Mechanical Electrical (nominal load) per Hour (nominal load)	 $>2 \times 10^7$ $>1 \times 10^5$ Max. 600
Switching Frequency (nominal load)	Max. 10 Hz
Dielectric Strength Contact Contact - Coil	 280 VAC (voltage limitation) 2000 VAC / 1 min
Power Consumption	Max. 8 W
Dimensions (H, W, D) [mm]	285, 40, 185

8.4.2 Output Circuit



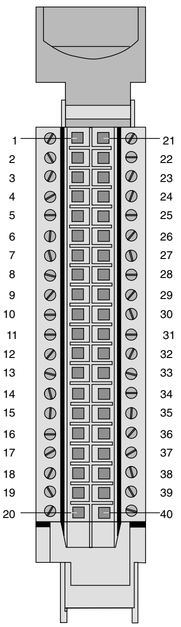
8.4.3 Status LEDs



Indicates the status of the terminal block, i.e. if this LED is lit, either no terminal block is connected or the terminal block which is connected is not connected properly.

1 ... **32** LEDs 1 to 32 indicate the logical status of the respective output.

8.4.4 Terminal Assignments



TB140

Terminal	Description		Terminal	Description	
1	Output 1	Group 1	21	Output 17	Group 5
2	Output 2		22	Output 18	
3	Output 3		23	Output 19	
4	Output 4		24	Output 20	
5	COM (1-4)		25	COM (17-20)	
6	Output 5	Group 2	26	Output 21	Group 6
7	Output 6		27	Output 22	
8	Output 7		28	Output 23	
9	Output 8		29	Output 24	
10	COM (5-8)		30	COM (21-24)	
11	Output 9	Group 3	31	Output 25	Group 7
12	Output 10		32	Output 26	
13	Output 11		33	Output 27	
14	Output 12		34	Output 28	
15	COM (9-12)		35	COM (25-28)	
16	Output 13	Group 4	36	Output 29	Group 8
17	Output 14		37	Output 30	
18	Output 15		38	Output 31	
19	Output 16		39	Output 32	
20	COM (13-16)		40	COM (29-32)	

8.4.5 Variable Declaration

Function	Variable Declaration				
	Scope	**Data Type**	**Length**	**Module Type**	**Channel**
Single Digital Output (Channel x)	tc_global	BIT	1	Digital Out	1 ... 32
Read terminal block status Bit 0 = 1............No terminal block connected Bit 0 = 0............Terminal block connected properly	tc_global	BYTE	1	Status In	0

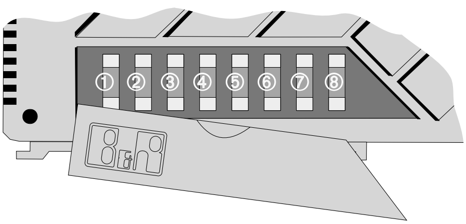
8.4.6 Fuses

A cover can be found on the right-hand side of the module housing, under which the fuses for the DO600 module are located. The following fuses are used:

Fuse:	10 A slow-blow (minimum. 8 A)

The fuses may only be exchanged if power is not being supplied to the module (Terminal block disconnected and module removed from base plate)

DO600 Fuses



Fuse	Output
①	29 32
②	13 16
③	25 28
④	9 12
⑤	21 24
⑥	5 8
⑦	17 20
⑧	1 4

8.5 DO700

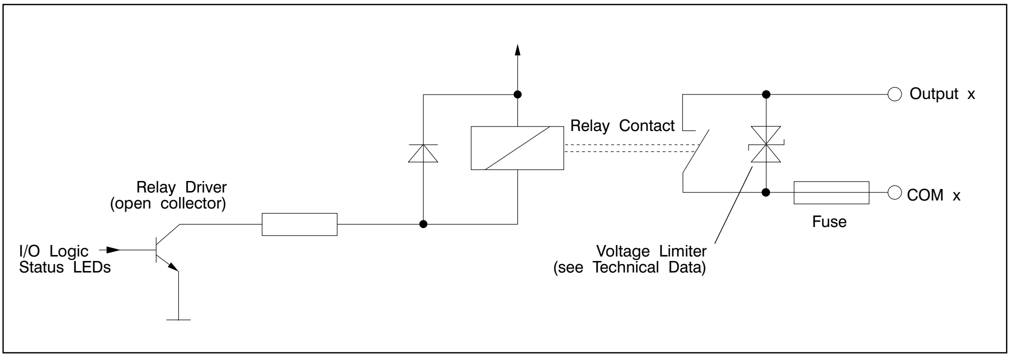
8.5.1 Technical Data

Module ID	DO700
Model Number	2DO700.6
Description	2010 Digital Output Module, 16 relay outputs 230 VAC / 24 VDC, 3 A, 4 electrically isolated output groups, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$07
Base Plate Module	BP200, BP201, BP210
Number of Outputs Total in 4 Groups of	 16 4
Type	Relay / normally open
Electrical Isolation Output - PCC Group - Group Output - Output	 Yes Yes No
Switching Voltage Nominal Maximum	 230 VAC / 24 VDC 250 VAC / 30 VDC
Continuous Current Per Output per Group Module	 Max. 3 A Max. 8 A Max. 16 A
Switching Power Minimum Maximum	 1 mA / 5 VDC 750 VA / 90 W

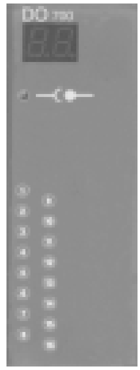
Chapter 3
B&R 2010 Modules

Module ID	DO700
Switching Delay	Approx. 10 msec
Short Circuit Protection	Fuse 10 A (at least 8 A) slow-blow per group
External Protective Circuit	Generally required
Voltage Limits on Relay Contacts	400 V_{ss}
Contact Resistance at Maximum Load	30 mΩ
Switching Cycle Mechanical Electrical (nominal load) per Hour (nominal load)	 $>2 \times 10^7$ $>1 \times 10^5$ max. 600
Switching Frequency (nominal load)	max. 10 Hz
Dielectric Strength Contact Contact - Coil	 280 VAC (voltage limitation) 2000 VAC / 1 min
Relative Humidity	0 to 95 % (non-condensing)
Dimensions (H, W, D) [mm]	285, 40, 185

8.5.2 Output Diagram

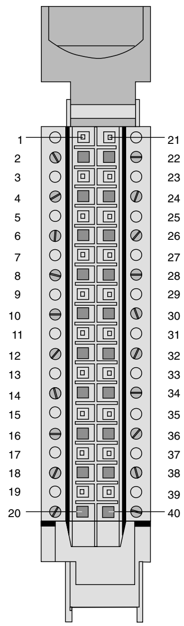


8.5.3 Status LEDs



—‹ ●—	Indicates the status of the terminal block, i.e. if this LED is lit, either no terminal block is connected or the terminal block which is connected is not connected properly.
1 ... **16**	LEDs 1 to 16 indicate the logical status of the respective output.

8.5.4 Terminal Assignments



TB120

Terminal	Description		Terminal	Description	
1		Group 1	21		Group 3
2	Output 1		22	Output 9	
3			23		
4	Output 2		24	Output 10	
5			25		
6	Output 3		26	Output 11	
7			27		
8	Output 4		28	Output 12	
9			29		
10	COM (1-4)		30	COM (9-12)	
11		Group 2	31		Group 4
12	Output 5		32	Output 13	
13			33		
14	Output 6		34	Output 14	
15			35		
16	Output 7		36	Output 15	
17			37		
18	Output 8		38	Output 16	
19			39		
20	COM (5-8)		40	COM (13-16)	

8.5.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Digital Output (Channel x)	tc_global	BIT	1	Digital Out	1 ... 16
Read terminal block status Bit 0 = 1 .... No terminal block connected Bit 0 = 0 .... Terminal block connected properly	tc_global	BYTE	1	Status In	0

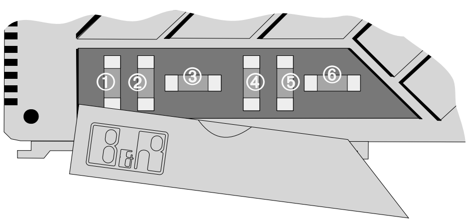
8.5.6 Fuses

A cover can be found on the right-hand side of the module housing, under which the fuses for the DO700 module are located. The following fuses are used:

Fuse:	10 A slow-blow (minimum. 8 A)

The fuses may only be exchanged if power is not being supplied to the module (Terminal block disconnected and module removed from base plate)

DO700 Fuses



Fuse	Output
①	13 16
②	5 8
③	Reserve
④	1 4
⑤	9 12
⑥	Reserve

8.6 DO710

8.6.1 Technical Data

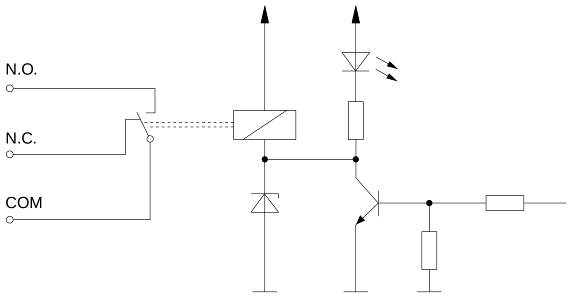
Module ID	DO710
General	
Model Number	2DO710.6
Description	2010 Digital Output Module, 16 relay outputs 240 VAC / 30 VDC, 4 A, single channel isolated outputs, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$27
Base Plate Module	BP200, BP201, BP210
Output Circuit	see section "Output Circuit"
Static Characteristics	
Module Type	B&R 2010 I/O module single width
Number and Type of Outputs	8 change-over 8 normally open Single channel isolation
Maximum Switching Voltage	125 VDC / 264 VAC
Maximum Peak Voltage	Externally limited to max. 460 V
Rated Voltage	30 VDC / 240 VAC
Switching Voltage Range	Min. 5 VDC @ 1 mA
Rated Frequency	DC or 45 - 63 Hz
Rated Current (1-Signal) Ie	4 A (resistive load)

Module ID	DO710
Current Range for 1-Signal (continually at maximum voltage) DC AC	 1 mA - 4 A (resistive load) 100 mA - 8 A (resistive load)
Switching Power	2000 VA; 120 W @ 30 VDC (resistive load)
Contact Resistance (DC)	Max. 100 mΩ @ 6 VDC / 100 mA
Power Loss on Contact (AC)	Typ. 1 W (max. 5 W)
Fuse-R	External fuse
Connection	8 change-over / 8 normally open
Power Consumption Internal External	 Max. 7 W Max. 8 W
Additional Characteristics	
Status Display	1 yellow LED per channel
Protective Characteristics	
Type of Protection Short Circuit Protection AC DC Overvoltage Protection for Contacts For DC Connection	 Fuse 8 A slow-blow (required externally) Fuse 4 A slow-blow (required externally) Limited to 460 V (required externally) Spark suppression if necessary (connected externally)
Dynamic Characteristics	
Output Delay for Signal Change from log 0 - log 1 log 1 - log 0	 Max. 13 msec (incl. chatter time) Max. 13 msec (incl. chatter time)
Operating Characteristics	
Effect of Incorrectly Connecting the Outputs	No implications for the module
Behaviour of Outputs by Controller Failure through the Main Processing Unit, Voltage Breakdown, Interruption and when Switching On/Off	Outputs are reset in the event of malfunction (note normally closed contacts)
Relay Contact Life-span	see section "Switching Cycles"
Total Output Current Following Conditions must be Fulfilled Wire Cross Section	max. 64 A $\Sigma I_n^2 \leq 400$ see section "Total Output Current" 2.5 mm², for currents ≥4 A or one of the recommended values is reached
Isolation Voltage under Normal Operating Conditions between Channel and Bus Other Channel Supply Interface	 1 Minute 2800 VAC or 4 kV @ 1.2 x 50 µsec pulse 1 Minute 1000 VAC or 1.4 kV @ 1.2 x 50 µsec pulse ---
Isolation between Open Relay Contacts	1 Minute 1000 VAC or 1.4 kV @ 1.2 x 50 µsec pulse

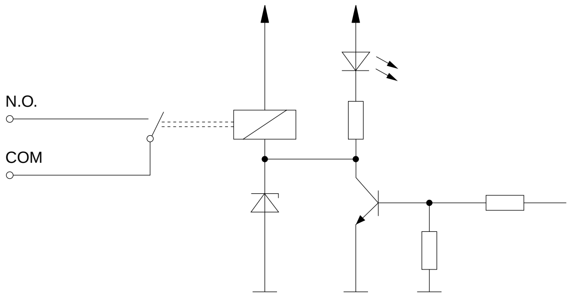
Module ID	DO710
Different Phases Possible	Yes, but only for 110 VAC
Starting Point of LED for a Channel	Control signal from relay coil
Method of Operation	Latches set on bus using transistor relay drivers
Typical Example for External Connections	Standard connection of normally open and change-over contacts, Sink and source connections possible
Mechanical Characteristics	
Dimensions	B&R 2010 single width
Terminal Assignments	see section "Terminal Assignments"

8.6.2 Output Circuit

Change-over contact



Normally open contact

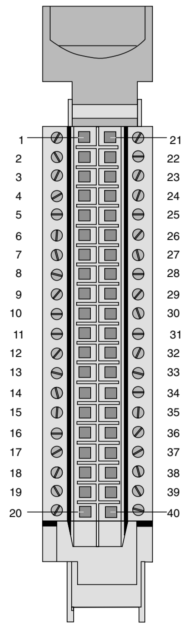


8.6.3 Status-LEDs

—‹ ●— Indicates the status of the terminal block, i.e if this LED is lit either no terminal block is connected or that it is not connected properly.

1 ... 16 LEDs 1 to 16 show the logical status of the corresponding output. The LED lights when the relay has a contact (normally open closes, normally closed opens).

8.6.4 Terminal Assignments



TB140

Terminal	Description		Terminal	Description	
1	Output 1	COM	21	Output 9	COM
2	Output 1	Normally open	22	Output 9	Normally open
3	Output 1	Normally closed	23	Output 9	Normally closed
4	Output 2	COM	24	Output 10	COM
5	Output 2	Normally open	25	Output 10	Normally open
6	Output 3	COM	26	Output 11	COM
7	Output 3	Normally open	27	Output 11	Normally open
8	Output 4	Normally closed	28	Output 12	Normally closed
9	Output 4	Normally open	29	Output 12	Normally open
10	Output 4	COM	30	Output 12	COM
11	Output 5	COM	31	Output 13	COM
12	Output 5	Normally open	32	Output 13	Normally open
13	Output 5	Normally closed	33	Output 13	Normally closed
14	Output 6	COM	34	Output 14	COM
15	Output 6	Normally open	35	Output 14	Normally open
16	Output 7	COM	36	Output 15	COM
17	Output 7	Normally open	37	Output 15	Normally open
18	Output 8	Normally closed	38	Output 16	Normally closed
19	Output 8	Normally open	39	Output 16	Normally open
20	Output 8	COM	40	Output 16	COM

Note that the maximum potential difference may not be exceeded between terminal block contacts. This is valid for:

Potential difference between	Voltage
COM x ↔ PCC ground	250 VAC
COM x ↔ ground	250 VAC

8.6.5 Total Output Current

The DO710 digital output module is set for a total output current of 64 A. The following condition should be fulfilled to ensure protection against the module overheating:

$$\Sigma I_n \leq 64\ A \quad \text{and} \quad \Sigma I_n^2 \leq 400$$

n ... channel numbers 1 to 16

Cable Cross Section

Connection cables with a cross section of 2.5 mm² are required for currents of ≥4 A or when on of the above recommended values has been reached.

Calculation Example

Example 1

Each of the 16 channels is loaded with 4 A.

1) Recommended value 1: Total current ≤ 64 A
   I_{total} = 16 x 4 A = 64 A -> condition fulfilled
2) Recommended value 2: $\Sigma I_n^2 \leq 200$
   $\Sigma I_n^2 = 16 \times 4^2 = 256$ -> condition fulfilled

Both conditions are fulfilled. The load is therefore permitted. Connection cables with a cross section of 2.5 mm² are required.

Example 2

Three channels are supplied with a maximum current of 8 A.

1) Recommended value 1: Total current ≤ 64 A
   I_{total} = 6 x 8 A = 48 A -> condition fulfilled
2) Recommended value 2: $\Sigma I_n^2 \leq 400$
   $\Sigma I_n^2 = 6 \times 8^2 = 384$

Both conditions are fulfilled. The load is permitted. Connection wires with a cross section of 2.5 mm² are required.

8.6.6 Switching Cycles

Mechanical Load

Relay contacts are capable of 5×10^6 switching cycles.

Electrical Load

The following table contains an overview of switching cycles that can be supplied with electric loads by the DO710.

Valid for each specification:
- ❍ Maximum 30 switching cycles a minute
- ❍ Values for normally open and normally closed contacts, but not for both.

Load	Switching cycle
Nominal load 8 A, 230 VAC, resistive	1×10^5
Motor load 230 VAC (switching current 12 A, cos φ 0.5, nom. load 1.8 A)	4×10^5
Valve load 0.1 A, 230 VAC	1×10^6
Hydraulic valve 2 A, 24 VDC (with external spark extinguisher)	1×10^6
8 A, 30 VDC, resistive	>1000
1 A, 24 VDC	2×10^5

8.6.7 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Digital Output (Channel x)	tc_global	BIT	1	Digital Out	1 ... 16
Read terminal block status Bit 0 = 1 .... No terminal block connected Bit 0 = 0 .... Terminal block connected properly	tc_global	BYTE	1	Status In	0

9 ANALOG INPUT MODULES

9.1 GENERAL INFORMATION

Analog input modules are used to convert measured values (voltages, currents, temperatures) to numbers that can be processed in the PCC. Basic difference:

Measurement of	Module ID
Current, Voltage	AIxxx
Temperature	ATxxx

Analog data is stored in the PCC in data format INT16 (16 bit 2's complement), regardless of the resolution. This means that while creating the application program, no reference needs to be made to the resolution of the module (step count).

The module sends measurement values in 0.1 °C steps for temperature measurements. This means that a result of 750 corresponds to 75.0 °C. Data format 0.1 °C is supported by all temperature input modules. Some modules also support other formats.
All analog input modules have a "RUN" status LED. This indicates that the A/D converter is running.

By default, the measurements for temperature input modules are made every 20 msec. This filters out the 50 Hz hum of the mains power in Europe. In countries with 60 Hz (e.g. Canada & USA), the conversion frequency can be switched to 16.67 msec.

9.1.1 Overview

Module	Number of Inputs	Input Signal Measurement Range	Sensor	Resolution
AI300	16	±10 V		12 Bit
AI700	16	±20 mA		12 Bit
AI730	8	0 - 25 mA		16 Bit
AT300	8	-50 to +450 °C	PT100 / 3 wire	20000 steps internal
AT610	16	-200 to +950 °C -200 to +1300 °C	FeCuNi sensor, Type L, J NiCrNi sensor, Type K	internal >14 Bit

9.1.2 Programming

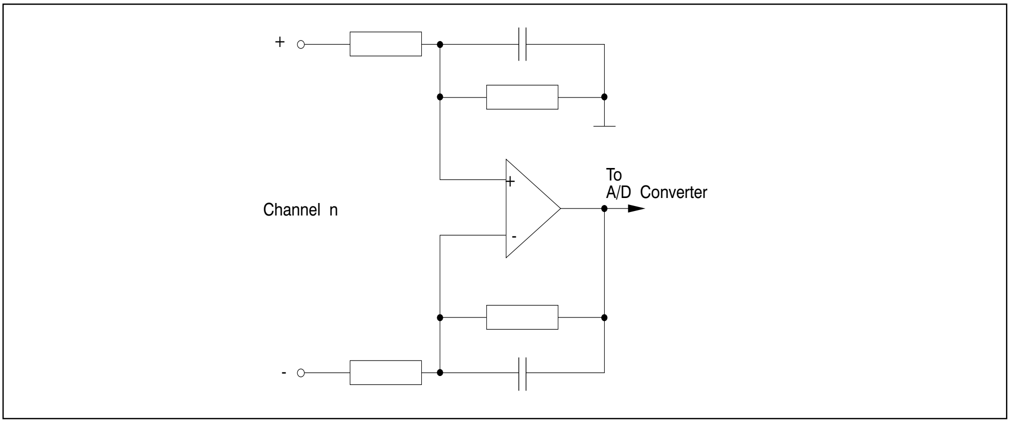
Analog inputs are addressed directly via their variable names in the application program. The relationship between the input channels of a certain module and the variable names is defined in the variable declaration (see "B&R 2000 Software User's Manual", Chapter "Programming System PG2000"). The declaration is made exactly the same for every programming language with the help of a table editor.

9.2 AI300

9.2.1 Technical Data

Module ID	AI300
Model Number	2AI300.6
Description	2010 Analog Input Module, 16 inputs, +/- 10 V, 12 Bit, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$08
Base Plate Module	BP200, BP201, BP210
Number of Inputs	16 voltage inputs
Electrical Isolation Input - PCC Input - Input	 Yes No
Input Signal Nominal Min./Max.	 -10 to +10 V -20 to +20 V
Resolution	12 Bit
Conversions Time for All Channels	1 msec
Differential Input Resistance	1 MΩ
Input Filter	Cutoff frequency: 400 Hz
Measurement Precision Basic Precision at 20 °C Precision (0 to 60 °C) Common Mode Rejection	 ±0.25 % ±0.5 % 40 dB / 50 Hz
Power Consumption	Max. 9 W
Dimensions (H, W, D) [mm]	285, 40, 185

9.2.2 Input Circuit

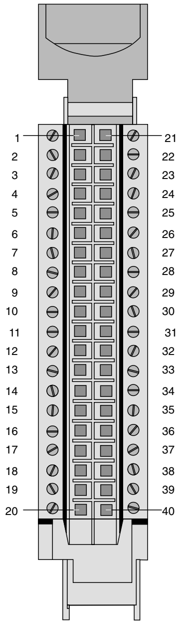


9.2.3 Status LEDs

 Indicates the status of the terminal block, i.e. if this LED is lit there is either no terminal block connected or the terminal block is improperly connected .

RUN Indicates that the analog / digital converter is running and the module is accessed through the I/O bus.

9.2.4 Terminal Assignments



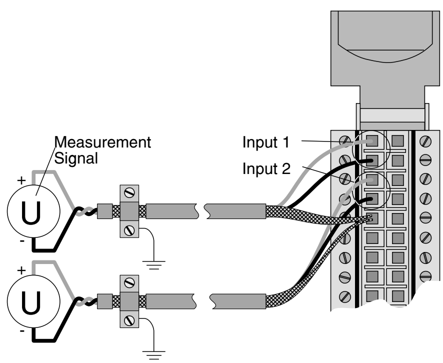
TB140

Terminal	Description	Terminal	Description
1	+ Input 1	21	+ Input 9
2	- Input 1	22	- Input 9
3	+ Input 2	23	+ Input 10
4	- Input 2	24	- Input 10
5	Shield	25	Shield
6	+ Input 3	26	+ Input 11
7	- Input 3	27	- Input 11
8	+ Input 4	28	+ Input 12
9	- Input 4	29	- Input 12
10	Shield	30	Shield
11	+ Input 5	31	+ Input 13
12	- Input 5	32	- Input 13
13	+ Input 6	33	+ Input 14
14	- Input 6	34	- Input 14
15	Shield	35	Shield
16	+ Input 7	36	+ Input 15
17	- Input 7	37	- Input 15
18	+ Input 8	38	+ Input 16
19	- Input 8	39	- Input 16
20	Shield	40	Shield

Connecting the Signal Cable

Shielded cable must be used for analog input modules. The shielding is done for two inputs at a time to the shield connection provided on the terminal block.

The eight shielded terminals are connected to ground ($\perp$,i.e.: contact spring and mounting rail).



9.2.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Input (channel x)	tc_global	INT16	1	Analog In	1 ... 16
Read Terminal Status ... Bit 0 = 1 .... No terminal block connected Bit 0 = 0 .... Terminal block connected properly	tc_global	BYTE	1	Status In	0

9.2.6 Relationship between Input Voltage and Converter Value

The converter value (INT16 format) changes in steps of 16 (..., -16, 0, 16, 32, ...).

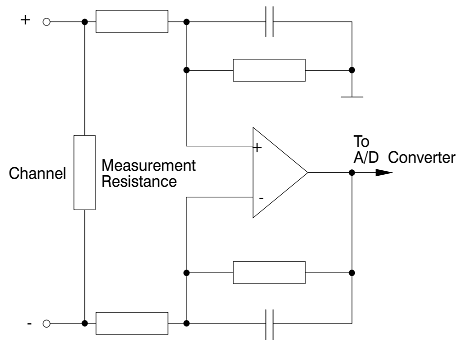
Voltage	Converter Value	
	Hexadecimal	Decimal
≤-10 V	8000	-32768
-4.88 mV	FFF0	-16
0 V	0000	0
4.88 mV	0010	16
≥10 V	7FF0	32752

9.3 AI700

9.3.1 Technical Data

Module ID	AI700
Model Number	2AI700.6
Description	2010 Analog Input Module, 16 inputs , +/- 20 mA, 12 Bit, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$09
Base Plate Module	BP200, BP201, BP210
Number of Inputs	16 current inputs
Electrical Isolation Input - PCC Input - Input	 Yes No
Input Signal Nominal Min./Max.	 -20 to +20 mA -30 to +30 mA
Resolution	12 Bit
Conversion Time for all Channels	1 msec
Load	50Ω
Voltage Drop at 20 mA	1 V
Input Filter	Cutoff frequency: 400 Hz
Measurement Precision Basic Precision at 20 °C Precision (0 to 60 °C) Common Mode Rejection	 ±0.25 % ±0.375 % 40 dB / 50 Hz
Power Consumption	Max. 9 W
Dimensions (H, W, D) [mm]	285, 40, 185

9.3.2 Input Circuit

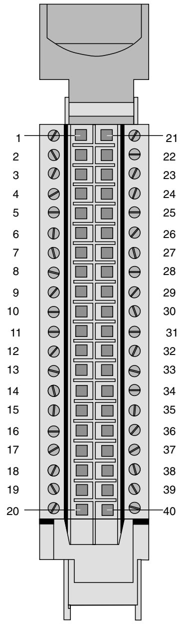


9.3.3 Status LEDs

Indicates the status of the terminal block, i.e. if this LED is lit there is either no terminal block connected or the terminal block is improperly connected .

RUN Indicates that the analog / digital converter is running and the module is accessed through the I/O bus.

9.3.4 Terminal Assignments



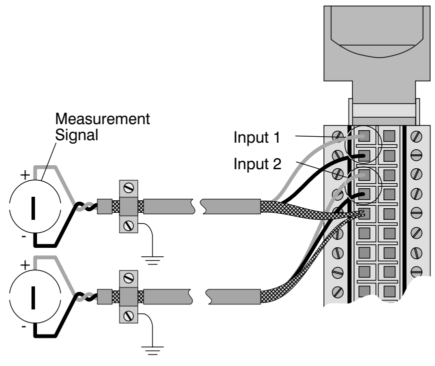
TB140

Terminal	Description	Terminal	Description
1	+ Input 1	21	+ Input 9
2	- Input 1	22	- Input 9
3	+ Input 2	23	+ Input 10
4	- Input 2	24	- Input 10
5	Shield	25	Shield
6	+ Input 3	26	+ Input 11
7	- Input 3	27	- Input 11
8	+ Input 4	28	+ Input 12
9	- Input 4	29	- Input 12
10	Shield	30	Shield
11	+ Input 5	31	+ Input 13
12	- Input 5	32	- Input 13
13	+ Input 6	33	+ Input 14
14	- Input 6	34	- Input 14
15	Shield	35	Shield
16	+ Input 7	36	+ Input 15
17	- Input 7	37	- Input 15
18	+ Input 8	38	+ Input 16
19	- Input 8	39	- Input 16
20	Shield	40	Shield

Connecting the Signal Cable

Shielded cable must be used for analog input modules. The shield connection is made two inputs at a time to the shield connection provided on the terminal block.

The eight shield terminals are connected to ground (⏚,i.e. contact spring and mounting rail).



9.3.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Input (channel X)	tc_global	INT16	1	Analog In	1 ... 16
Read Terminal Status ... Bit 0 = 1 .... No terminal block connected Bit 0 = 0 .... Terminal block connected properly	tc_global	BYTE	1	Status In	0

9.3.6 Relationship between Input Current and Converter Value

The converter value (INT16 format) changes in steps of 16 (..., -16, 0, 16, 32, ...).

Current	Converter Value	
	Hexadecimal	Decimal
≤-20 mA	8000	-32768
-9.766 µA	FFF0	-16
0 A	0000	0
9.766 µA	0010	16
≥20 mA	7FF0	32752

9.4 AI730

9.4.1 Technical Data

Module ID	AI730
General	
Model Number	2AI730.6
Description	2010 Analog Input Module, 8 inputs, 0 - 25 mA, 16 Bit, single channel isolation, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$28
Base Plate Module	BP200, BP201, BP210
Static Characteristics	
Module Type	B&R 2010 I/O Module single width
Input Type	Current signal 0 - 25 mA
Number of Inputs	8
Encoder Supply Voltage Current	 18 - 30 VDC Max. 30 mA
Common Potential between Channels	None (single channel isolation)
Protection of all Channel Connections against Overvoltage / Reverse Polarity	Up to 42 VDC
Overload Display	LED

Module ID	AI730
Digital Values Output in Overload Conditions Over Range Under Range	Depends on module configuration $7FFF $8001
Digital Converter Resolution	16 Bit
Data Format Sent to in Application Program Not Scaled 0 mA 20 mA Scaled 4 mA 20 mA	INT16 (binary) $0000 $7FFF $0000 (basic setting for k and d or for value pairs) $7FFF (basic setting for k and d or for value pairs)
Conversion Method	Sigma Delta
Conversion Time Continuous Mode 50 Hz 60 Hz Trigger Mode 50 Hz 60 Hz	 20 msec 16.67 msec 60 msec 50 msec
Input Impedance in Signal Range	Max. 130Ω
Zero Point Error at 25 °C	±0.002 % 1)
Precision at 25 °C	±0.042 % 1)
Offset Drift	±0.0002 %/°C 1)
Gain Drift	±0.004 %/°C 2)
Common Mode Range	±300 VAC/VDC
Noise (peak to peak)	±0.0008 % 1)
Cross talk between Channels with DC Voltage, 50 Hz, 60 Hz and up to 300 VAC/VDC	<1 LSB
Linearization Method	Electronic adjustment of the module Measurement value adjustment possible through application software
Measurement Range	0 - 25 mA @ converter resolution 16 Bit
Circuit	See example in section "Terminal Block Connection"
Power Consumption	Max. 6 W + 1 W for each internally supplied encoder
Dynamic Characteristics	
Total system input transfer time	System cause cyclically in task class intervals
Analog Filter Cutoff Frequency transconductance step response	 80 Hz 20 dB/Decade 63 % in 2 msec
Digital Filter from First Notch Frequency of 50 Hz or 60 Hz	>120 dB
Maximum Momentary Deviation during every Electrical Interference Test	±1 %
Operating Characteristics	
Working Voltage Channel to Ground Channel to Channel Channel to Shield	 Max. 300 V_{eff} Max. 600 V_{eff} Max. 300 V_{eff}

Module ID	AI730
Pulse Dielectric Strength at 2000 m above Sea Level Channel to Ground Channel to Channel Channel to shield	 4000 V 4000 V 2500 V
Operating Modes Operating Mode 1 Operating Mode 2	Additional information in section "General Information" Continuous mode (standard mode) Trigger mode
Calibration or Testing to Maintain Precision Class	None
Non-linearity	<0.003 % 1)
Mechanical Characteristics	
Dimensions	B&R 2010 single width
Terminal Assignments	see section "Terminal Assignments"

1) Refers to measurement range (0 - 25 mA)

2) Refers to current measurement

9.4.2 General Information

The AI730 is an 8 channel analog input module. The channels are used individually. Each channel uses its own analog/digital converter.
Each channel utilizes its own encoder supply that is electrically isolated from the other channels.

Operating Modes

There are two possible settings for the AI730. The operating type set is valid for all eight channels.

1) Continuous Mode

The continuous mode is also known as the standard mode. This mode is automatically set when you turn on the AI730. The analog/digital converters run simultaneously and convert the individual channels as fast as possible.

2) Trigger Mode

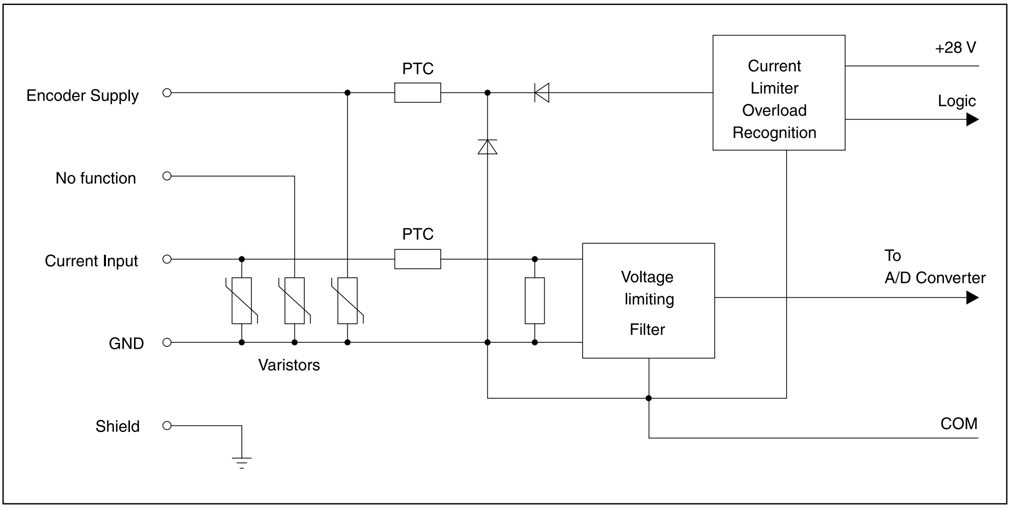
The trigger mode is set by entering Bit 0 in the configuration register. Analog/digital conversion of a measurement cycle is activated by a trigger pulse.

Scaling

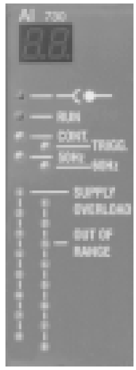
The input signal is converted into a raw value by the analog/digital converter. A measurement value is calculated from this raw value which can be used in the application program.
The AI730's operating system also offers the possibility to scale values. In this case the measured value is converted to the physical units set by the user (see section "Scaling").

9.4.3 Input Circuit

The following diagram shows the input circuit for a channel. All channels are constructed in the same way.



9.4.4 Status LEDs



—< ●— Indicates the status of the terminal block i.e. if this LED is lit either no terminal is connected or the one that is connected is not connected properly.

RUN Indicates that the analog/digital converter is running and the module is being accessed through the I/O bus.

CONT. Continuous mode (standard mode) is set.

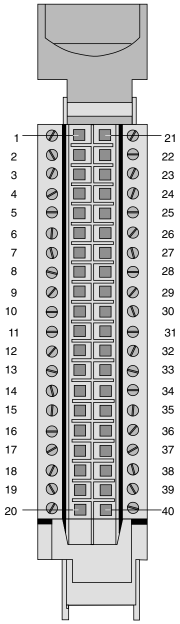
TRIGG. Trigger mode is set. The LED is lit when a trigger pulse for all eight channels is received and starts a measurement cycle.

50 Hz Filter time is 20 msec.

60 Hz Filter time is 16.67 msec.

Supply Overload	Periodic	...	Over current or short circuit has occurred.
	Blink signal	...	When the supply overload LED is blinking the converter for this function is not working.
	Double pulse	...	When the supply overload LED is blinking in a double pulse, the channel supply has an over current or a short circuit and the converter for this channel is not working.
Out of Range	Periodic	...	The input signal for this channel exceeds the valid range.
	Blink signal	...	When the Out of Range LED is blinking the converter for this channel is not working.
	Double pulse	...	When the Out of Range LED is blinking in a double pulse, the channels input signal exceeds the valid range and the converter for this channel is not working.

9.4.5 Terminal Assignments



TB140

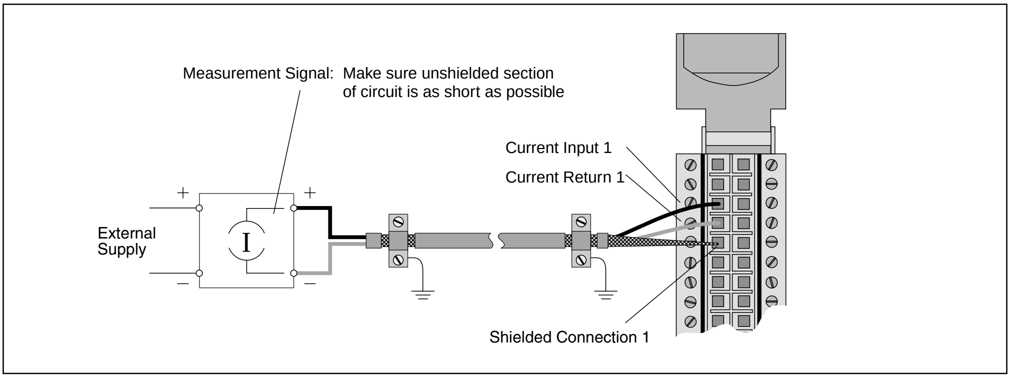
Terminal	Description	Terminal	Description
1	+ Supply1 (+24 VDC)	21	+ Supply 5 (+24 VDC)
2	N.C.	22	N.C.
3	Current input 1	23	Current input 5
4	- Supply 1, Current return path 1	24	- Supply 5, Current return path 5
5	Shield 1	25	Shield 5
6	+ Supply2 (+24 VDC)	26	+ Supply6 (+24 VDC)
7	N.C.	27	N.C.
8	Current input 2	28	Current input 6
9	- Supply 2, Current return path 2	29	- Supply 6, Current return path 6
10	Shield 2	30	Shield 6
11	+ Supply3 (+24 VDC)	31	+ Supply7 (+24 VDC)
12	N.C.	32	N.C.
13	Current input 3	33	Current input 7
14	- Supply 3, Current return path 3	34	- Supply 7, Current return path 7
15	Shield 3	35	Shield 7
16	+ Supply4 (+24 VDC)	36	+ Supply8 (+24 VDC)
17	N.C.	37	N.C.
18	Current input 4	38	Current input 8
19	- Supply 4, Current return path 4	39	- Supply 8, Current return path 8
20	Shield 4	40	Shield 8

Connecting the Signal Cable

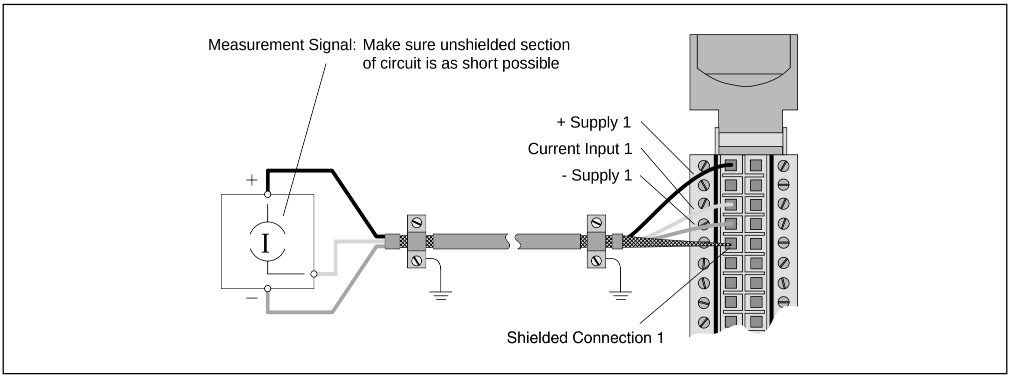
Shielded cables should be used for connecting analog input modules. Shielding for each input is made on the shield connection on the terminal block.

When a module channel is connected through a circuit that is not equipped with sufficient electric shock protection, all shields that are connected to shielded terminals on the module are either to be protected with additional isolation or grounded !

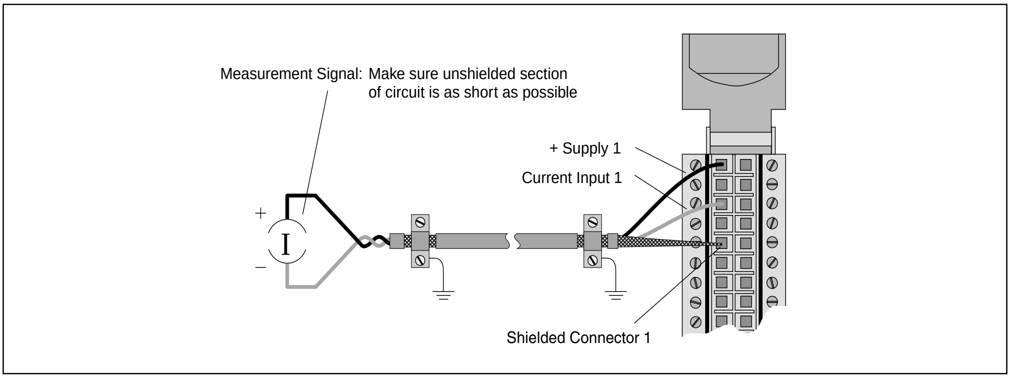
Encoder Connection with External Supply



Encoder Connection with Internal Supply



Two Wire Connection Supplied via AI730



9.4.6 Variable Declaration

Data Range

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Read single analog input (channel x) The measured value or the standard measured value are read after each setting.	tc_global	INT16	1	Analog In	1 ... 8
Read number of valid measurements per channel	tc_global	WORD	1	Analog In	17 ... 24
Define lowest value limit (standard setting: $8000) Lowest value limit < measured value< highest value limit	tc_global	INT16	1	Analog Out	49 ... 56
Define highest value limit (standard setting: $7FFF) Lowest value limit< measured value< highest value limit	tc_global	INT16	1	Analog Out	57 ... 64
Scaling using coordinate pair: Definition of x0 per channel	tc_global	INT16	1	Analog Out	65 ... 72
Scaling using coordinate pair: Definition of x1 per channel	tc_global	INT16	1	Analog Out	73 ... 80
Scaling using coordinate pair: Definition of y0 per channel	tc_global	INT16	1	Analog Out	81 ... 88
Scaling using coordinate pair: Definition of y1 per channel	tc_global	INT16	1	Analog Out	89 ... 96
Scaling using slope in k and offset d. Definition of gradient k per channel (for number format see "Scaling").	tc_global	INT32	1	Transp. Out	192 ... 220
Scaling using slope in k and offset d. Definition of offsets d per channel (for number format see "Scaling").	tc_global	INT32	1	Transp. Out	224 ... 252

Status Range

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Read terminal block status Bit 0 = 0: Terminal block installed Bit 0 = 1: Terminal block removed	tc_global	BYTE	1	Status In	0
Read module status (see section "status register")	tc_global	BYTE	1	Status In	1
Lowest value limit is not reached, each Bit corresponds to a channel Bit 0 = Channel 1: 0 - Signal OK, 1 - Signal under value limit Bit 7 = Channel 8: 0 - Signal OK, 1 - Signal under value limit	tc_global	BYTE	1	Status In	2
Highest limit value is exceeded, each Bit corresponds to a channel Bit 0 = Channel 1: 0 - Signal OK, 1 - Signal over value limit Bit 7 = Channel 8: 0 - Signal OK, 1 - Signal over value limit	tc_global	BYTE	1	Status In	3
ADC Error. The analog/digital converter of the corresponding channel is not responding. Each Bit corresponds to a channel. Bit 0 = Channel 1: 0 - Converter OK, 1 - Converter defect Bit 7 = Channel 8: 0 - Converter OK, 1 - Converter defect	tc_global	BYTE	1	Status In	4
VCC Error. The corresponding channel supply is overloaded. Each Bit corresponds to a channel. Bit 0 = Channel 1: 0 - supply OK, 1 - supply overload Bit 7 = Channel 8: 0 - supply OK, 1 - supply overload	tc_global	BYTE	1	Status In	5
Trigger pulse by setting Bit 7	tc_global	BYTE	1	Status Out	8
Module configuration (see section "Configuration Register")	tc_global	BYTE	1	Status Out	9
Scaling off/on, each Bit corresponds to a channel Bit 0 = Channel 1: 0 - Scaling off, 1 - Scaling on Bit 7 = Channel 8: 0 - Scaling off, 1 - Scaling on	tc_global	BYTE	1	Status Out	11
Scaling using two pairs of coordinates (x0/y0) and (x1/y1) or gradient k and Offset d. Each Bit corresponds to a channel. Bit 0 = Channel 1: 0 - two coordinate pairs, 1 - increase and Offset Bit 7 = Channel 8: 0 - two coordinate pairs, 1 - increase and Offset	tc_global	BYTE	1	Status Out	12
Scaling absolute/relative (see section "Absolute or Relative Scaling "). Each Bit corresponds to a channel. Bit 0 = Channel 1: 0 - absolute Scaling , 1 - relative Scaling Bit 7 = Channel 8: 0 - absolute Scaling , 1 - relative Scaling	tc_global	BYTE	1	Status Out	13
Read SW version (see section "SW Version")	tc_global	BYTE	4	Status In	16

Status Register

Bit	Description
7	0 ... Measurement running 1 ... Measurement finished. The Bit is set differently for each operating mode: Continuous mode .... after the first measurement Trigger mode .... after every measurement
6	0 ... The measured value corresponds to the definition 1 ... There is a system failure. This means that the measured value does not correspond to the definition. If this occurs please contact B&R.
5	This Bit only has one function, if Bit 4 is set in the configuration register (error is only displayed in the respective status register) 0 ... The measured value is not limited 1 ... The measured value limited by the upper and lower value limits.
4	0 ... The error is displayed in both the status register and the measurement value display. $7FFF ....Over run $8001.....Under run $8000.....ADC Error 1 ... Error is only displayed in the respective status register (Over run, Under run, ADC Error)
3	0
2	0 ... Filter 50 Hz (20 msec measurement cycle) 1 ... Filter 60 Hz (16.67 msec measurement cycle)
1	0
0	0 ... Continuous mode 1 ... Trigger mode

				0		0	

7 0

Configuration Register

Bit	Description
7	0
6	0
5	This Bit only has one function, if Bit 4 is set (error is only displayed in the corresponding status register). 0 ... The measured value is not limited (basic setting) 1 ... The measured value is limited by the upper and lower value limits.
4	0 ... The error is displayed in both the status register (basic setting) $7FFF.... Over run $8001..... Under run $8000..... ADC Error 1 ... The error is only displayed in the respective status register. (Over run, Under run, ADC Error)
3	0
2	0 ... Filter 50 Hz (20 msec measurement cycle) (basic setting) 1 ... Filter 60 Hz (16.67 msec measurement cycle)
1	0
0	0 ... Continuous mode (basic setting) 1 ... Trigger mode

7							0
0	0			0		0	

Software version

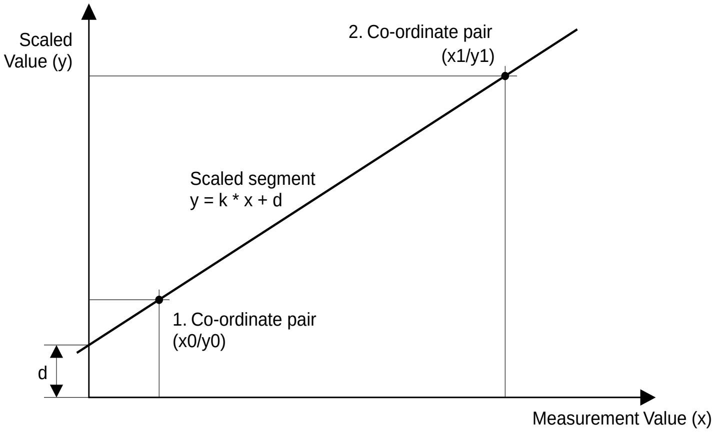
The software version is saved as a 4 byte ASCII String. Version 1.0 comes with the following ASCII String:

Byte 1	Byte 2	Byte 3	Byte 4
V	**1**	**.**	**0**

9.4.7 Scaling

General Information

Scaling assigns a physical unit to the measured value. The conversion is made along a scaled line segment:



Scaled segment calculation: y = k * x + d

y ..... linear value
k ..... slope
x ..... measured value
d ..... y, if x = 0 (Offset)

Defining the Scaled Line Segment

Definition can be carried out in two different ways:

- using two coordinate pairs
- using slope k and offset d

Defining the Line Segment using Two Coordinate Pairs

If the slope and the offset for the calculation are not known, the definition of the scaled segment takes place using two coordinate pairs (x0/y0) and (x1/y1).

Default setting: 4 mA ... $0000
20 mA ... $7FFF

Determining the Coordinate- Pairs

The coordinate pairs are determined using the physical units corresponding to the values y0 and y1 and the measured values corresponding to values x0 and x1. The values for y0 and y1 (set values) are known. x0 and x1 (actual values) are determined in the following manner:

No.	Instructions to be carried out
1	Create conditions that correspond to the first coordinate pair (x0/y0) (weight, pressure, etc.). The settings correspond to the minimum encoder values.
2	Read and store the measured values.
3	Create conditions that correspond to the first coordinate pair (x1/y1). The settings correspond to the maximum encoder values.
4	Read and store the measured values.

Data for Scaling

The data required for scaling is defined in the initialization sub-program. Then scaling is turned on.

Instructions to be carried out		
Definition of x0 per channel	Analog Out	65 ... 72
Definition of x1 per channel	Analog Out	73 ... 80
Definition of y0 per channel	Analog Out	81 ... 88
Definition of y1 per channel	Analog Out	89 ... 96
Scaling on	Status Out	11

Defining the Line Segment using the Slope and Offset

If the slope k and offset d for the calculation are known, the definition of the scaled segment takes place using these two parameters.

Default setting: 4 mA ... $00000000
20 mA ... $7FFF0000

Format

The format of k and d is INT32. The most significant 2 bytes are the whole number section and the least significant 2 bytes are the positions after the decimal point. Both values must be multiplied by 65536 in order to continue processing.

Example: k = 2.4 and d = 0.5

Slope = k x 65536 = 2.4 x 65536 =157286 = $00026666

Offset = d x 65536 = 0.5 x 65536 = 32768 = $00008000

Data for Scaling

The data required for scaling is defined in the initialization sub-program. Then scaling is turned on.

Instructions to be carried out		
Definition of slope k per channel	Transp. Out	192 ... 220
Definition of offsets d per channel	Transp. Out	224 ... 252
Scaling on	Status Out	11

Special Functions

- Other scaling parameters can be set for each channel.
- Scaling can be turned off/on separately for each channel.
- Absolute or relative scaling can be carried out for each channel.

Absolute or Relative Scaling

1) Absolute Scaling

Absolute scaling is normally used. The slope k and the offset d are taken directly by the AI730 operating system or calculated from the transferred coordinate pairs.

2) Relative Scaling

Relative scaling can be used e.g. during start-up or to adjust the calculation for different operating conditions. With relative scaling, the AI730 stores the current slope and offset when turned off. The parameter given during the boot phase for k and d are not used directly. They are used as a factor. The new slope and offset are calculated with the help of this factor:

$$k_{new} = k_{old} \times k_{factor}$$
$$d_{new} = d_{old} \times k_{factor} + d_{factor}$$

9.4.8 Start-up

1) Configure module
2) Define upper and lower limits
3) Define if scaling will take place using two coordinate pairs or slope k and offset d
4) Define coordinate pair or k and d for scaling
5) Define if absolute or relative scaling will take place
6) Scaling off/on. Converter is handled differently according to the operating made:

Continuous Mode:	Converter started
Trigger Mode:	Converter can be started for one measurement cycle using a trigger pulse

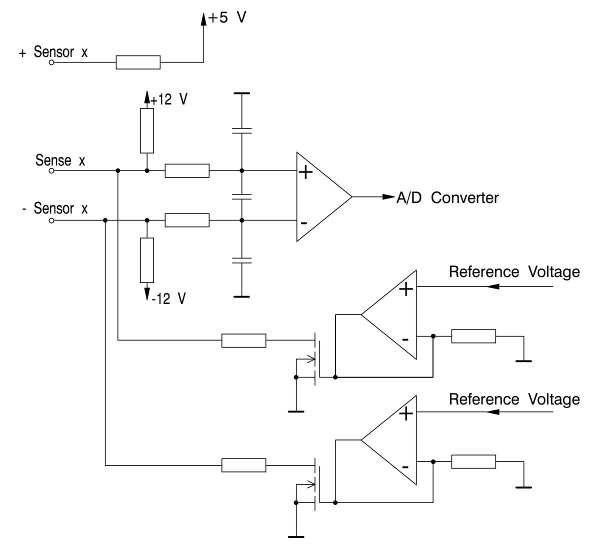
9.5 AT300

9.5.1 Technical Data

Module ID	AT300
Model Number	2AT300.6
Description	2010 Analog Input Module, 8 inputs, PT100 (3-wire connection), -50 to +450 degrees C, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$0A
Base Plate Module	BP200, BP201, BP210
Number of Inputs Total in 2 Groups of	 8 inputs for resistance measurement 4
Electrical Isolation Input - PCC Group - Group Input - Input	 Yes Yes No
Sensor Type Connection Standard	 PT100 3-wire connection IEC/EN 60751
Measurement Range	-50 to +450 °C
Resolution	Internal 20000 steps
Measurement Procedure	Integrated converter
Measurement Time per Channel	33 msec
Conversion Time for all Channels	160 msec

Module ID	AT300
Input Filter	Bessel low pass 2nd order / cutoff frequency: 8 Hz
Precision Basic Precision at 25 °C Precision (0 to 60 °C)	 ±0.1 % ±0.2 %
Linearization	Automatic in the module
Measurement Current	2 mA (±0.2 %)
Power Consumption	Max. 9 W
Dimensions (H, W, D) [mm]	285, 40, 185

9.5.2 Input Circuit

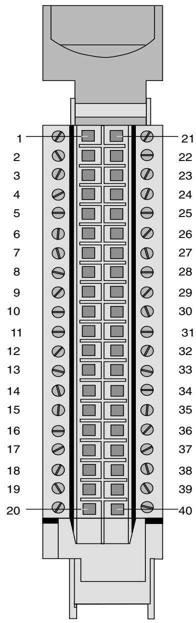


9.5.3 Status LEDs

Indicates the status of the terminal block, i.e. if this LED is lit there is either no terminal block connected or the terminal block is improperly connected .

RUN Indicates that the analog / digital converter is running and the module is accessed through the I/O bus.

9.5.4 Terminal Assignments



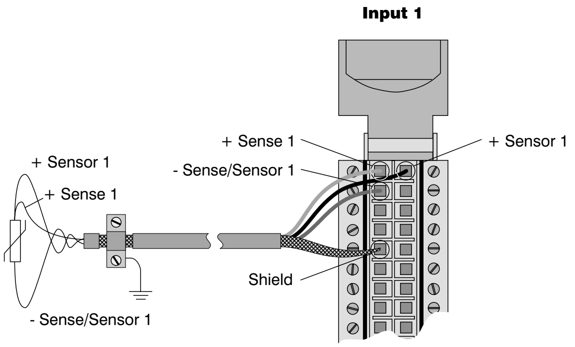
TB140

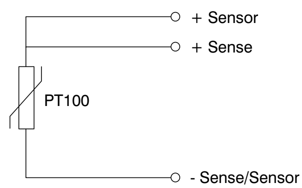
Terminal	Description		Terminal	Description	
1	+ Sense 1	Group 1	21	+ Sensor 1	Group 1
2	- Sense/Sensor 1		22	----	
3	+ Sense 2		23	+ Sensor 2	
4	- Sense/Sensor 2		24	----	
5	Shield		25	Shield	
6	+ Sense 3		26	+ Sensor 3	
7	- Sense/Sensor 3		27	----	
8	+ Sense 4		28	+ Sensor 4	
9	- Sense/Sensor 4		29	----	
10	Shield		30	Shield	
11	+ Sense 5	Group 2	31	+ Sensor 5	Group 2
12	- Sense/Sensor 5		32	----	
13	+ Sense 6		33	+ Sensor 6	
14	- Sense/Sensor 6		34	----	
15	Shield		35	Shield	
16	+ Sense 7		36	+ Sensor 7	
17	- Sense/Sensor 7		37	----	
18	+ Sense 8		38	+ Sensor 8	
19	- Sense/Sensor 8		39	----	
20	Shield		40	Shield	

Connecting the Signal Cable

All wiring for the temperature sensor must be carried out with shielded cable. The shielding is wired to shield connectors on the terminal block.

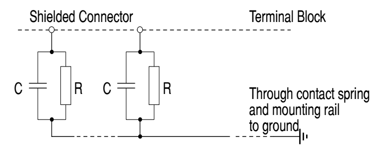
3 Wire Connection





All shield connections are of equal value and are connected to ground (⊥,i.e.: contact spring and mounting rail) over an RC circuit.

R: 22 kΩ
C: 10 nF / 60 V



For a three line connection, only sensors for which the connection lines are of equal value are to be used, i.e. same length, same cross section, same material and therefore the same resistance.

The maximum total resistance between the + and - sensor connections may not exceed 600 Ω, otherwise the overload on the internal current source will lead to measurement errors.

Sensors or sense lines must not be grounded or connected with other connection lines for other sensors.

9.5.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Input in 0.1 °C data format (channel x)	tc_global	INT16	1	Analog In	1 ... 8
Single Analog Input in 0.01 °C data format (channel x)	tc_global	INT16	1	Analog In	17 ... 24
Read Status Register	tc_global	BYTE	1	Status In	0
Read Over Range of Measurement Register	tc_global	BYTE	1	Status In	2
Read Under Range of Measurement Register	tc_global	BYTE	1	Status In	4
Read Broken Contact Register	tc_global	BYTE	1	Status In	21

Several registers which are reserved for service purposes can be found in the status area of the AT300 modules. It is recommended, in the interest of the user, that only those registers described are used in the application program !

Status Register

REGISTER READ	Bit	Description
	7	DV1 - Measurement value validity
	6	DV2
	5	OVR - Measurement over-range
	4	UNR - Measurement under-range
	3	MOD_1 - Module identification
	2	MOD_2
	1	
	0	FKL - Terminal block status

DVx Measurement value validity:

DV1	DV2	Note
0	0	Internal error. Contact your technical advisor at B&R.
0	1	Internal error. Contact your technical advisor at B&R.
1	0	Internal error. Contact your technical advisor at B&R.
1	1	All temperature values are valid.

OVR
0 ..... No Measurement Over-Range. The temperature values of all inputs are under the allowable upper limit (+450 °C).
1 ..... Measurement Over-Range. The temperature value of at least one input has exceeded (+450 °C).

UNR
0 ..... No Measurement Under-Range. The temperature values of all inputs are over the allowable lower limit (-50 °C).
1 ..... Measurement Under-Range. The temperature value of at least one input is under (-50 °C).

MOD_x Module identification:

MOD_1	MOD_2	Note
0	0	Internal error. Contact your technical advisor at B&R.
0	1	Module: AT300 (RTD sensor, 3 line)
1	0	Module: AT400 (RTD sensor, 4 line)
1	1	Internal error. Contact your technical advisor at B&R.

FKL
0 ..... Terminal block is connected properly.
1 ..... No terminal block connected.

Measurement Over-Range-Register (Measurement Over-Range: Temperature value > +450 °C)

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Over-Range	NO	YES [1)]
	6	Input 7: Measurement Over-Range	NO	YES [1)]
	5	Input 6: Measurement Over-Range	NO	YES [1)]
	4	Input 5: Measurement Over-Range	NO	YES [1)]
	3	Input 4: Measurement Over-Range	NO	YES [1)]
	2	Input 3: Measurement Over-Range	NO	YES [1)]
	1	Input 2: Measurement Over-Range	NO	YES [1)]
	0	Input 1: Measurement Over-Range	NO	YES [1)]

7 0

[1)] If the respective input is open, the bit is also set to log. 1.

Measurement Under-Range-Register (Measurement Under-Range: Temperature value < -50 °C)

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Under-Range	NO	YES
	6	Input 7: Measurement Under-Range	NO	YES
	5	Input 6: Measurement Under-Range	NO	YES
	4	Input 5: Measurement Under-Range	NO	YES
	3	Input 4: Measurement Under-Range	NO	YES
	2	Input 3: Measurement Under-Range	NO	YES
	1	Input 2: Measurement Under-Range	NO	YES
	0	Input 1: Measurement Under-Range	NO	YES

7 0

Broken Contact-Register

REGISTER READ	Bit	Description	0	1
	7	Input 8: Broken Contact or Open Input	NO	YES
	6	Input 7: Broken Contact or Open Input	NO	YES
	5	Input 6: Broken Contact or Open Input	NO	YES
	4	Input 5: Broken Contact or Open Input	NO	YES
	3	Input 4: Broken Contact or Open Input	NO	YES
	2	Input 3: Broken Contact or Open Input	NO	YES
	1	Input 2: Broken Contact or Open Input	NO	YES
	0	Input 1: Broken Contact or Open Input	NO	YES

7 0

9.5.6 Relationship between Temperature and Converter Value

Data Format 0.1 °C

Temperature	Converter Value	
	Hexadecimal	Decimal
< -50.0 °C	FE0C	-500
-50.0 °C	FE0C	-500
:	:	:
-0.1 °C	FFFF	-1
0.0 °C	0000	0
0.1 °C	0001	1
:	:	:
450.0 °C	1194	4500
> 450.0 °C	1194	4500

Value in the range between (-50 to 450 °C) correspond with the precision, which is indicated in the technical data!

Values outside of the range between (-50 to 450 °C) give a value of (-50 °C for under ranged measurements and (450 °C) for over ranged measurements.

Data Format 0.01 °C

Temperature	Converter value	
	Hexadecimal	Decimal
< -50.00 °C	EC79	-4999
-50.00 °C	EC79	-4999
-49.99 °C	EC79	-4999
-49.98 °C	EC7A	-4998
:	:	:
-0.10 °C	FFFF	-1
0.00 °C	0000	0
0.10 °C	0001	1
:	:	:
327.67 °C	7FFF	32767
> 327.67 °C	7FFF	32767

With this data format, the measurement range remains (-50 °C to 450 °C). Because of the data format however, the output range is limited and values between 327.67 to +450 °C are no longer displayed. These are seen as value 32767 (7FFF).
For temperatures (≤ -50 °C) the module internal calculation outputs a value of -4999 (EC79).

Values within the range from (-50 to 327.67 °C) correspond with the precision, which is indicated in the technical data!

Values outside of the range from (-50 to 327.67 °C) are output as (-49.99 °C) for under-range and as (327.67 °C) for over-range.

9.6 AT610

9.6.1 Technical Data

Module ID	AT610
General	
Model Number	2AT610.6
Description	2010 Analog Input Module, 16 inputs, temperature sensor, Type L/J/K, -200 to +1300 degrees C, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$25
Base Plate Module	BP200, BP201, BP210
Number of Inputs Distribution Group 1 Group 2 Group 3 Group 4 Input Signal Nominal Allowed Differential Input Resistance Input Filter Common Mode Rejection Max. Modulation Compared to Ground between 2 Elect. Isolated Groups Common Mode Control between Two Channels in a Group	16 differential inputs for thermocouples 4 groups Channels 1 - 4 Channels 5 - 8 Channels 9 - 12 Channels 13 - 16 -15 to +55 mV -20 to +20 V >1 MΩ Bessel low pass 2nd order, cutoff frequency 8 Hz, Measured using NOTCH characteristic method (according to measurement time) 80 dB (DC) 75 dB (50 Hz) ±50 V ±50 V ±9 V

Module ID	**AT610**
Electrical Isolation Input - PCC Group 1 - Group 3 Group 2 - Group 4 Groups 1+3 - Groups 2+4 Input - Input (same group)	 Yes No No Yes No
Measurement Procedure Conversion Principle Measurement Time per Channel	 Integrated (voltage / frequency converter) Can be set to 20 msec / 16.67 msec / 10 msec / 8.33 msec (AT610 operation)
Resolution	Internal >14 Bit (23841 internal ADC converter values at 20 msec)[1]
Quantization Internal Output	 2.936 µV 0.1 °C (temperature measurement) 2.0 µV (scaled voltage raw value)
Internal Reference Junction Temperature Determination	 Temperature profile measurement in module with four temperature sensors Reference junction temperature determined for each channel separately
Measurement Precision (natural convection)	Max. ±4 °C over entire environmental temperature range (0 to 60 °C) Typ. +3 °C / -1 °C at 25 °C environmental temperature
Repeat Precision	±0.1 °C
Status Display Terminal ok RUN LED 10 Status LEDs	 Red Green Yellow
Operating Modes	AT600 compatible (standard setting) AT610
Power Consumption	Max. 8 W
Dimensions (H, W, D) [mm]	285, 40, 185

Operating Mode	**AT610**			
Set per Group[2]				
Sensor				
Model	FeCuNi	FeCuNi	NiCrNi	Raw Value Measurement
Type	L	J	K	----
Standard	DIN 43710	DIN IEC 584	DIN IEC 584	Scaled to 2 µV
Measurement Voltage Range	-8.15 to 53.14 mV[2]	-7.89 to 54.95 mV[2]	-5.891 to 52.398 mV[2]	-15 to +55 mV
Measurement Range in 0.1 °C Steps	-200.0 to +900.0 °C	-200.0 to +950.0 °C	-200.0 to +1300.0 °C	According to sensor
Linearization	Yes	Yes	Yes	in CPU
Reference Junction Measurement				
Internal	-20 to +90 °C			Can be read
External	-100 to +200 °C (can be set)			----

Conversion Time	
Measurement Time per Conversion	Can be set to 20 msec / 16.67 msec / 10 msec / 8.33 msec
Calculation Time per Channel Pair	6 msec
Measurement Time for Internal Reference Junction	26 msec
Maximum Cycle Time	

	50 Hz	60 Hz
8 * (meas. time per conversion + calc. time)	8 * (20 + 6) msec	8 * (16.67 + 6) msec
Reference junction meas. (if activated)	26 msec	26 msec
Results in a cycle time of	234 msec	207.36 msec

Module ID	AT610
Basic Precision at 25 °C	±25 µV (±0.036 %) [3]
Offset Drift	±1.1 µV/°C (±0.0016 %/°C) [4]
Gain Drift	±0.006 %/°C [5]
Repeat Precision (meas. time 20 msec)	±0.008 % [4]
Operating Mode	**AT600**
Sensor Model Type Standard Measurement Range in 0.1 °C Steps Linearization Terminal Temperature Compensation	 FeCuNi L DIN 43710 -50.0 to +750.0 °C Yes -20 to +90 °C from internal reference junction measurement
Conversion Time Measurement Time per Conversion Maximum Cycle Time	 20 msec 235 msec

1) The internal resolution is different according to the measurement time, but the conversion value is scaled to 20 msec. This means that value changes are avoided when setting measurement times!

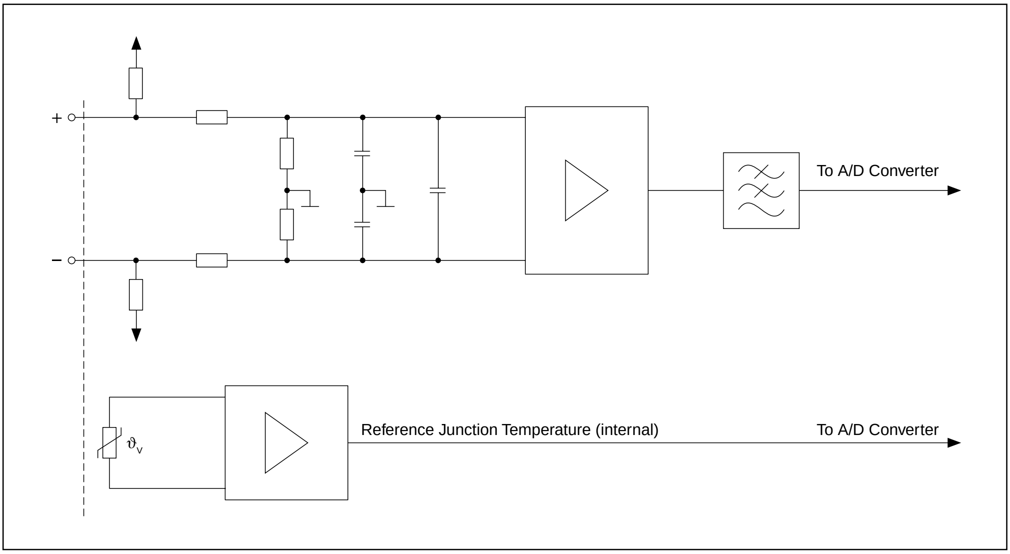
2) Scaled to 0 °C reference junction temperature.

3) Without consideration for reference junction measurement errors.

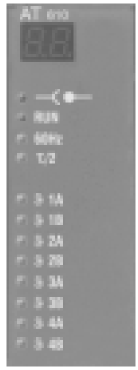
4) Refers to the measurement range of 70 mV.

5) Refers to the current measurement value.

9.6.2 Input Circuit



9.6.3 Status LEDs



In the AT600 operating method only the terminal status LED and the RUN LED are active.

—(●— Indicates the terminal block status i.e when the LED lights no terminal block connected to the module or that the terminal block is not connected properly.

RUN Indicates that the analog/digital converter is running.

60Hz This LED indicates which Enable time is switched on. When this LED is lit, the Enable time is set to 16.67 msec through which 60 Hz mains hum is filtered out. Otherwise a Enable time of 20 msec is selected.
The Enable time is valid for all 16 channels.

Default: 50 Hz; 60Hz LED not lit

τ/2 The LED is indicates that half the Enable time is set.
When this LED lights, the Enable time required is 10 msec or 8.33 msec (independent of whether the 60Hz LED lights or not).

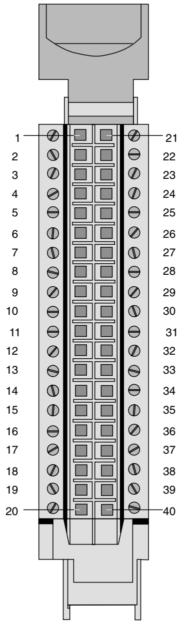
Default: Full Enable time; τ/2 LED not lit

ϑxA/ϑxB These LEDs show the temperature sensor type setting for group x (1 - 4).

Default: Sensor type L; ϑxA/ϑxB LEDs not lit

ϑ4		ϑ3		ϑ2		ϑ1		Sensor Type
B	A	B	A	B	A	B	A	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	L - Default or false setting in mode register 2
OFF	ON	OFF	ON	OFF	ON	OFF	ON	J
ON	OFF	ON	OFF	ON	OFF	ON	OFF	K
ON	ON	ON	ON	ON	ON	ON	ON	U invalid status (Error)

9.6.4 Terminal Assignments



TB140

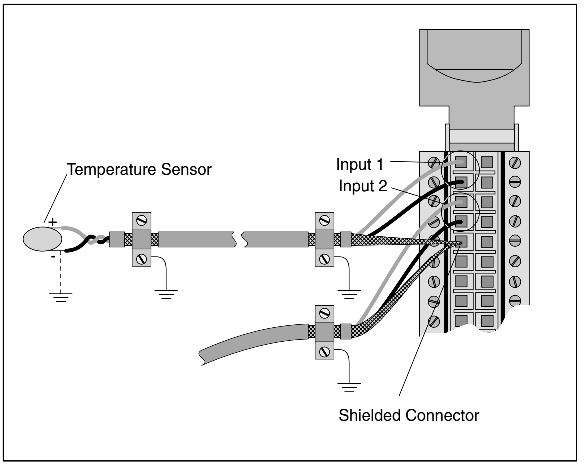
Terminal	Description			Terminal	Description		
1	+ Sensor Input	1	Group 1	21	+ Sensor Input	9	Group 3
2	- Sensor Input	1		22	- Sensor Input	9	
3	+ Sensor Input	2		23	+ Sensor Input	10	
4	- Sensor Input	2		24	- Sensor Input	10	
5	Shield			25	Shield		
6	+ Sensor Input	3		26	+ Sensor Input	11	
7	- Sensor Input	3		27	- Sensor Input	11	
8	+ Sensor Input	4		28	+ Sensor Input	12	
9	- Sensor Input	4		29	- Sensor Input	12	
10	Shield			30	Shield		
11	+ Sensor Input	5	Group 2	31	+ Sensor Input	13	Group 4
12	- Sensor Input	5		32	- Sensor Input	13	
13	+ Sensor Input	6		33	+ Sensor Input	14	
14	- Sensor Input	6		34	- Sensor Input	14	
15	Shield			35	Shield		
16	+ Sensor Input	7		36	+ Sensor Input	15	
17	- Sensor Input	7		37	- Sensor Input	15	
18	+ Sensor Input	8		38	+ Sensor Input	16	
19	- Sensor Input	8		39	- Sensor Input	16	
20	Shield			40	Shield		

Connecting the Signal Cable

Shielded cable must be used for all temperature sensor connections. The shielding is done for two inputs at a time to the shield connection provided on the terminal block. For several thermocouple elements the sensor negative pin is grounded which does not affect the Enables one way or the other.

Open inputs should be closed for grounding reasons.

The eight shielded connections are equally rated and connected through 100 Ω resistors to ground (⏚, i.e contact spring and mounting rail).



Effect of Compensation Cable Lengths

Measurement errors are typically brought about by incorrectly selected cable resistance. With a cable resistance of 40 Ω (that requires a cable length of approx. 40 m) the measurement error amounts to 9 µV (respectively 0.013 % of the measurement range).

9.6.5 Variable Declaration

Operating Mode AT600

Function	Variable Declaration				
	Scope	**Data Type**	**Length**	**Module Type**	**Channel**
Single analog input (channel x)	tc_global	INT16	1	Analog In	1 ... 16
Status register AT600	tc_global	BYTE	1	Status In	0
Enable over range register for inputs 1 to 8	tc_global	BYTE	1	Status In	2
Enable over range register for inputs 9 to 16	tc_global	BYTE	1	Status In	3
Enable under range register for inputs 1 to 8	tc_global	BYTE	1	Status In	4
Enable under range register for inputs 9 to 16	tc_global	BYTE	1	Status In	5
Mode register 1	tc_global	BYTE	1	Status Out	8
Status register 1	tc_global	BYTE	1	Status In	8

Operating Mode AT610

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single analog input (channel x)	tc_global	INT16	1	Analog In	1 ... 16
Single analog input as standard raw value (channel x)	tc_global	INT16	1	Analog In	33 ... 48
Reference junction temperature in 0,1 °C single steps (channel x)	tc_global	INT16	1	Analog In	49 ... 64
Instruct ext. reference junction temperature in 0.1 °C steps (channel x)	tc_global	INT16	1	Analog Out	1 ... 16
Status register AT600	tc_global	BYTE	1	Status In	0
Modus register 1	tc_global	BYTE	1	Status Out	8
Modus register 2	tc_global	BYTE	1	Status Out	9
Modus register 4	tc_global	BYTE	1	Status Out	11
Status register 1	tc_global	BYTE	1	Status In	8
Status register 2	tc_global	BYTE	1	Status In	9
Status register 4	tc_global	BYTE	1	Status In	11

Operating Mode

The AT600 operating method is set after switching on or after a reset. In this operating status no mode setting except the switching of AT610 in mode register 1 can be carried out.

The AT610 module can replace the AT600 temperature input module in the existing application without changing the application program.

When a module is set in the AT610 operating mode, no further mode changes are possible.

Mode Register 1 (AT600 and AT610)

Bits 2 - 6 must always be set to 0 !

MODE REGISTER 1 WRITE	Bit	Description		
	7	$\tau/2$	-	Half Enable time
	6	0		
	5	0		
	4	0		
	3	0		
	2	0		
	1	AT610	-	Change operating method from AT600 -> AT610
	0	τ	-	Enable time 16.67 msec

7	6	5	4	3	2	1	0
	0	0	0	0	0		

τ 0 ..... Enable time per channel 20 msec (default)
50 Hz mains hum is filtered out
1 ..... Enable time per channel 16.67 msec
60 Hz mains hum is filtered out
No relevance for AT600 operating mode

τ/2 0 ..... Enable time is 20 msec or 16.67 msec dependent on Bit 0 (default).
1 ..... Half Enable time: Enable time is 10 msec or 8.33 msec dependent on Bit 0.
No relevance for AT600 operating mode

AT610 0 ..... Operating mode AT600 (default)
1 ..... Operating mode AT610
Only one change of operating mode is possible.

Mode Register 2 (AT610)

MODE REGISTER 2 WRITE	Bit	Description		
	7	ϑ4B	-	Sensor type for group 4 (channel 13 - 16)
	6	ϑ4A	-	Sensor type for group 4 (channel 13 - 16)
	5	ϑ3B	-	Sensor type for group 3 (channel 9 - 12)
	4	ϑ3A	-	Sensor type for group 3 (channel 9 - 12)
	3	ϑ2B	-	Sensor type for group 2 (channel 5 - 8)
	2	ϑ2A	-	Sensor type for group 2 (channel 5 - 8)
	1	ϑ1B	-	Sensor type for group 1 (channel 1 - 4)
	0	ϑ1A	-	Sensor type for group 1 (channel 1 - 4)

7	6	5	4	3	2	1	0

ϑ4		**ϑ3**		**ϑ2**		**ϑ1**		**Sensor Type**
B	**A**	**B**	**A**	**B**	**A**	**B**	**A**	
0	0	0	0	0	0	0	0	L (default)
0	1	0	1	0	1	0	1	J
1	0	1	0	1	0	1	0	K
1	1	1	1	1	1	1	1	U invalid sensor type. Distribution: -3276.8

Mode Register 4 (AT610)

Selective switching off of channels (disable) or the compensation temperature reduces the cycle time.

Bit 7 must be set to 0 !

MODE REGISTER 4 WRITE	Bit	Description
	7	0
	6	$COMP_{ext3+4}$ - Compensation temp external groups 3 and 4
	5	$KOMP_{ext1+2}$ - Compensation temp external group 1 and 2
	4	T_{Comp} - Disable update function for internal compensation
	3	C4/8/12/16 - Disable channels 4, 8, 12 and 16
	2	C3/7/11/15 - Disable channels 3, 7, 11 and 15
	1	C2/6/10/14 - Disable channels 2, 6, 10 and 14
	0	C1/5/9/13 - Disable channels 1, 5, 9 and 13

C1/5/9/13
0 ..... Enable channels 1, 5, 9 and 13 (default)
1 ..... Disable channels 1, 5, 9 and 13
The last enabled value is still received

C2/6/10/14
0 ..... Enable channels 2, 6, 10 and 14 (default)
1 ..... Disable channels 2, 6, 10 and 14
The last enabled value is still received

C3/7/11/15
0 ..... Enable channels 3, 7, 11 and 15 (default)
1 ..... Disable channels 3, 7, 11 and 15
The last enabled value is still received

C4/8/12/16
0 ..... Enable channels 4, 8, 12 and 16 (default))
1 ..... Disable 4, 8, 12 and 16
The last enabled value is still received

T_{Comp}
0 ..... The internal compensation temperature (terminal block temperature) is permanently updated (default)
1 ..... The internal compensation temperature is no longer updated. The last enabled value is still received and used for terminal block compensation.

$COMP_{ext\ 1+2}$
0 ..... Internal compensation is updated (terminal block temperature compensation is used - default)
1 ..... External compensation is updated (valid for groups 1 and 2).
When this operating method is selected, firmware does not use the measurement from the modules sensor for compensation. It is set instead of the value given by the user. These values are written in 0.1 °C steps in "Analog Out" channels 1 - 16 in the I/O range.

$COMP_{ext\ 3+4}$
0 ..... Internal compensation is updated (terminal block temperature compensation is used - default)
1 ..... External compensation is active (valid for groups 3 and 4).
When this operating method is selected, firmware does not use the enable from the modules sensor for compensation. It is set instead of the value given by the user. These values are written in 0.1 °C steps in "Analog Out" channels 1 - 16 in the I/O range.

Status Register AT600 Operating Modes (AT600 and AT610)

This Byte includes the status when operating mode AT600 is set. In operating mode AT610, the terminal status can only be evaluated with Bit 0. Bits 4 and 5 are always 0 in At610 mode !

STATUS REGISTER AT600 READ	Bit	Description
	7	x
	6	x
	5	OVR - Measurement Over Range
	4	UNR - Measurement Under Range
	3	x
	2	x
	1	x
	0	FKL - Terminal Status

x x x x x

7 0

FKL 0 ..... The terminal block is connected properly.
1 ..... No terminal block is connected.

UNR 0 ..... No Measurement Under-Range. The temperature values of all inputs are above the lower limit of the measurement range (-50 °C).
1 ..... Measurement Under-Range. The temperature values of at least one input is below (-50 °C).
Not applicable for AT600

OVR 0 ..... No Measurement Over-Range. The temperature values of all inputs are below the upper limits of the measurement range (750 °C).
1 ..... Measurement Over-Range. The temperature values of at least one input have exceeded (750 °C). An open input or a broken contact will also cause a log. 1 in this bit.
Not applicable for AT600

Measurement Over Range Register for Inputs 1 to 8 (AT600)

Measurement over range: Temperature value $\geq$ +750.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 1 to 8 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Over Range	No	Yes
	6	Input 7: Measurement Over Range	No	Yes
	5	Input 6: Measurement Over Range	No	Yes
	4	Input 5: Measurement Over Range	No	Yes
	3	Input 4: Measurement Over Range	No	Yes
	2	Input 3: Measurement Over Range	No	Yes
	1	Input 2: Measurement Over Range	No	Yes
	0	Input 1: Measurement Over Range	No	Yes

7 0

Measurement Over Range Register for Inputs 9 to 16 (AT600)

Measurement over range: Temperature value ≥ +750.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 9 to 16 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 16: Measurement Over Range	No	Yes
	6	Input 15: Measurement Over Range	No	Yes
	5	Input 14: Measurement Over Range	No	Yes
	4	Input 13: Measurement Over Range	No	Yes
	3	Input 12: Measurement Over Range	No	Yes
	2	Input 11: Measurement Over Range	No	Yes
	1	Input 10: Measurement Over Range	No	Yes
	0	Input 9: Measurement Over Range	No	Yes

7 0

Measurement Under Range Register for Inputs 1 to 8 (AT600)

Measurement over range: Temperature value ≤ -50.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 1 to 8 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Under Range	No	Yes
	6	Input 7: Measurement Under Range	No	Yes
	5	Input 6: Measurement Under Range	No	Yes
	4	Input 5: Measurement Under Range	No	Yes
	3	Input 4: Measurement Under Range	No	Yes
	2	Input 3: Measurement Under Range	No	Yes
	1	Input 2: Measurement Under Range	No	Yes
	0	Input 1: Measurement Under Range	No	Yes

7 0

Measurement Under Range Register for Inputs 9 to 16 (AT600)

Measurement under range: Temperature value ≤ -50.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 9 to 16 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 16: Measurement Under Range	No	Yes
	6	Input 15: Measurement Under Range	No	Yes
	5	Input 14: Measurement Under Range	No	Yes
	4	Input 13: Measurement Under Range	No	Yes
	3	Input 12: Measurement Under Range	No	Yes
	2	Input 11: Measurement Under Range	No	Yes
	1	Input 10: Measurement Under Range	No	Yes
	0	Input 9: Measurement Under Range	No	Yes

Status Register 1 (AT600 and AT610)

Status register 1 can be evaluated in both operating modes.

STATUS REGISTER 1 READ	Bit	Description
	7	x
	6	x
	5	x
	4	x
	3	x
	2	x
	1	AT610 - AT610 operating mode
	0	IERR - Module error

IERR 0 ..... Data value in the Dual Ported RAM corresponds to the definition.
1 ..... There is an internal error. This means that the data value in the Dual Ported RAM does not correspond to the definition. If this occurs, please contact B&R.

AT610 0 ..... Operating mode AT600
1 ..... Operating mode AT610

Status Registers 2 and 4

The settings for mode registers 2 and 4 are given again in mode registers 2 and 4. The settings become valid when the status register corresponds to the mode register.

Status Register 2 (AT610)

STATUS REGISTER 2 READ	Bit	Description	
	7	ϑ4B	- Sensor type for group 4 (channel 13 - 16)
	6	ϑ4A	- Sensor type for group 4 (channel 13 - 16)
	5	ϑ3B	- Sensor type for group 3 (channel 9 - 12)
	4	ϑ3A	- Sensor type for group 3 (channel 9 - 12)
	3	ϑ2B	- Sensor type for group 2 (channel 5 - 8)
	2	ϑ2A	- Sensor type for group 2 (channel 5 - 8)
	1	ϑ1B	- Sensor type for group 1 (channel 1 - 4)
	0	ϑ1A	- Sensor type for group 1 (channel 1 - 4)

7 0

Status Register 4 (AT610)

STATUS REGISTER 4 READ	Bit	Description	
	7	x	
	6	$COMP_{ext3+4}$	- Compensation temp. external Groups 3 and 4
	5	$COMP_{ext1+2}$	- Compensation temp. external Groups 1 and 2
	4	T_{Comp}	- Disable function for internal compensation update
	3	C4/8/12/16	- Disable channels 4, 8, 12 and 16
	2	C3/7/11/15	- Disable channels 3, 7, 11 and 15
	1	C2/6/10/14	- Disable channels 2, 6, 10 and 14
	0	C1/5/9/13	- Disable channels 1, 5, 9 and 13

x

7 0

9.6.6 AT600 Value Range

Measurement Point Temperature	
Temperature Range	Sensor type L: -500 to +7500 [0.1 °C]
Measurement Under Range	-500
Measurement Over Range	+7500
Sensor Break	+7500
Under Range compensation temperature	-500
Over Range compensation temperature	+7500
General Error	-32768

9.6.7 AT610 Value Range

Measurement Point Temperature	
Temperature Range	Sensor L: -2000 to +9000 [0.1 °C] Sensor J: -2000 to +9500 [0.1 °C] Sensor K: -2000 to +13000 [0.1 °C]
Measurement Under Range	-32767
Measurement Over Range	+32767
Broken Sensor	+32767
Range Exceed Compensation Temperature	-32768
General Error	-32768
ADC Raw Value for Voltage Measurement Range -15 mV to +55 mV	
Thermo Voltage Raw Value	-7500 to +27500 [2 µV]
Measurement Under Range	-32767
Measurement Over Range	+32767
Broken Sensor	+32767
General Error	-32768
Compensation Temperature (Internal or Default)	
Temperature Range	Internal: -200 to +900 [0.1 °C] Default: -1000 to +2000 [0.1 °C]
Measurement Over/Under Range Exceeded	Internal: An over/under range on a measurement point results in -32768 (error value) on all channels Default: An over/under range on a channel results in -32768 reading on that channel
General Error	-32768

9.6.8 Measurement Range Monitoring

1) Reasons for a Measurement Over Range

AT600: Registered value +7500
AT610: Registered value +32767

- ❍ No temperature sensor connected or broken sensor
- ❍ The input voltage brought about by the temperature sensor is bigger than the:
  - a) Voltage measurement range
  - b) Temperature sensor range

AT600 only

- ❍ Compensation temperature under range

2) Reasons for a Measurement Under Range

AT600: Registered value-500
AT610: Registered value -32767

- ❍ The input voltage brought about by the temperature sensor is smaller than the:
  - a) Voltage measurement range
  - b) Temperature sensor range

AT600 only

- ❍ Compensation temperature over range

AT610 only

- ❍ A non-permitted temperature sensor is set (see mode register 2)
- ❍ Positive or negative measurement exceeding of the internal or external comparison temperature

3) Short Circuit Monitoring

A short circuit is a valid operating status (0 mV). Therefore, this error status must be confirmed by carrying out a plausibility test in the application program.
B&R recommends carrying out plausibility monitoring through additional logic when 0 °C is also recorded in the application operating range.
Example: When the heating of $\Delta t = n$ sec is turned on, the temperature must increase by 2 °C (experimental value, that can also be determined adaptively).

9.6.9 Installation Instructions

- ❍ Artificial convection reduces the internal compensation temperature by raising the ambient temperature of the AT610 (by approx. ±2 °C).
- ❍ For EMV reasons it is recommended to jumper any open inputs.
- ❍ The AT610 reaches the correct operating temperature for determining the compensation temperature 5 minutes after turning on the controller. The declared measurement precision becomes valid at this point.

9.6.10 Internal Measurement Processing

A scaled raw value is created from the input voltage which has a linear relationship to the input voltage. The thermo element temperature (for the given thermocouple type) is calculated from this raw value, taking the reference junction temperature into consideration. Reference junction compensation and liniarization are carried out internally.

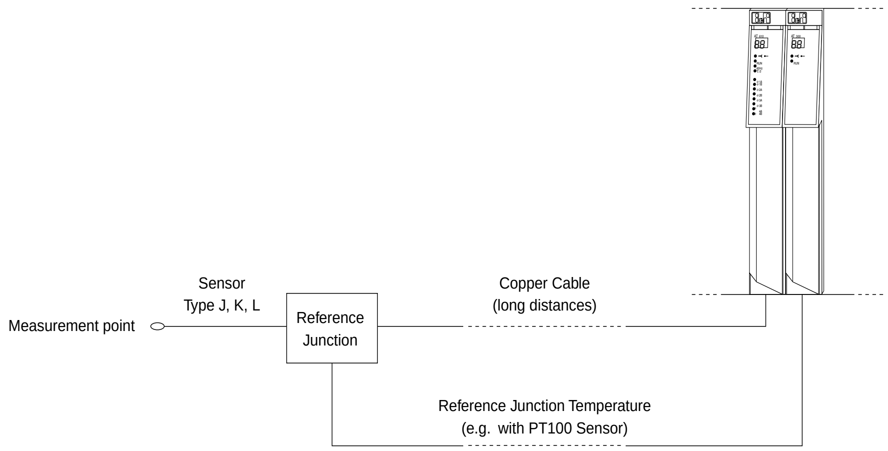
The reference junction temperature is calculated individually for each module channel. The required temperature measurement is carried out using four separate temperature sensors positioned along the terminal block. The reference junction temperature value can be read in the AT610 operating mode.

It is also possible to enter a reference junction temperature value for each channel which is used for the internal reference junction compensation instead of the measured value ("external reference junction"). Operating with external reference junction is only possible in the AT610 operating mode and can be set separately for two groups.

This results in the following special modes of operation

a) A thermo element other than the defined types (J, K, L) is connected. The thermo element temperature is calculated in an application program (main CPU) using the raw value and the reference junction temperature measured on the module (for each channel).

b) It is necessary to install an external reference junction (especially for long cables). However, the thermo element temperature should still be determined on a AT610 module.
The thermo element voltage is connected from the external reference junction to the terminal of the AT610 using copper cable which stores the temperature measured on the external reference junction (e.g. with PT100 - AT300) in the AT610 module's IO area. The AT610 internally calculates the desired thermo element temperature from the measured voltage and the reference junction temperature (per channel).



10 ANALOG OUTPUT MODULES

10.1 GENERAL INFORMATION

Analog output modules convert PCC internal number values to voltages or currents. The number values to be converted have to be in INT16 format (16 bit 2s complement). The conversion takes place independent of the resolution of the output module used.

All analog output modules have a "RUN" Status LED. This LED shows if the D/A conversion is running.

10.1.1 Overview

Module	Number of Outputs	Output Signal	Resolution
AO300	16	±10 V	12 Bit
AO725	8	0 to 20 mA	12 Bit
AO900	8 8	0 to 20 mA ±10 V	12 Bit 12 Bit

10.1.2 Programming

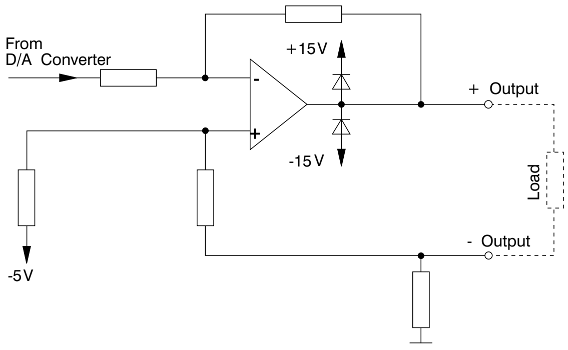
Analog outputs are addressed directly via their variable names in the application program (data type INT16). The relationship between the output channels of a certain module and the variable names is defined in the variable declaration (see "B&R 2000 Software User's Manual", Chapter "Programming System PG2000"). The declaration is made exactly the same for every programming language.

10.2 AO300

10.2.1 Technical Data

Module ID	AO300
Model Number	2AO300.6
Description	2010 Analog Output Module, 16 outputs , +/- 10 V, 12 Bit, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$11
Base Plate Module	BP200, BP201, BP210
Number of Outputs	16 voltage outputs (bipolar)
Electrical Isolation Output - PCC Output - Output	 Yes No
Output Signal	-10 to +10 V
Resolution	12 Bit
Conversion Time for all Outputs	250 µsec
Output Filter	Low pass 1st order / cutoff frequency: 1000 Hz
Max. Load per Output	±10 mA (load ≥ 1 kΩ)
Short Circuit Protection (current limit)	Max. ±15 mA
Precision Basic Precision (at 20 °C) Precision (0 to 60 °C)	 ±0.25 % ±0.5 %
Power Consumption	Max. 10 W
Dimensions (H, W, D) [mm]	285, 40, 185

10.2.2 Output Circuit

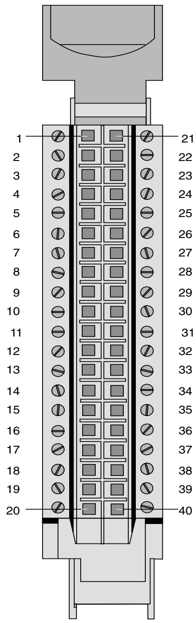


10.2.3 Status LEDs

—< ●— Indicates the status of the terminal block. i.e. if this LED is lit, either there is no terminal block connected or the terminal block is improperly connected. If the terminal block is not connected, (—< ●— is lit), all outputs are turned off and held to 0 V.

RUN Indicates that the analog outputs are operating and the terminal is inserted. The RUN LED goes out if the terminal block is removed.

10.2.4 Terminal Assignments



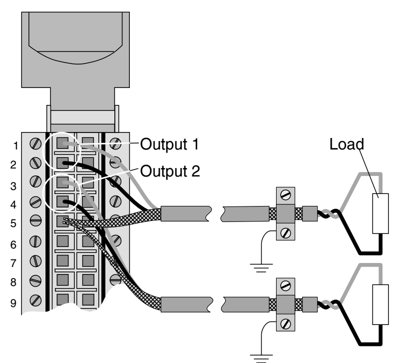
TB140

Terminal	Description	Terminal	Description
1	+ Output 1	21	+ Output 9
2	- Output 1	22	- Output 9
3	+ Output 2	23	+ Output 10
4	- Output 2	24	- Output 10
5	Shield	25	Shield
6	+ Output 3	26	+ Output 11
7	- Output 3	27	- Output 11
8	+ Output 4	28	+ Output 12
9	- Output 4	29	- Output 12
10	Shield	30	Shield
11	+ Output 5	31	+ Output 13
12	- Output 5	32	- Output 13
13	+ Output 6	33	+ Output 14
14	- Output 6	34	- Output 14
15	Shield	35	Shield
16	+ Output 7	36	+ Output 15
17	- Output 7	37	- Output 15
18	+ Output 8	38	+ Output 16
19	- Output 8	39	- Output 16
20	Shield	40	Shield

Connecting the Shield Cable

Shielded cables must be used for analog output modules. The shielding is done for two outputs at a time and connected to the provided grounding clamps.

The eight shielding connections are connected directly to ground (⏚,i.e.: spring contact and mounting rail).



10.2.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Output (Channel x)	tc_global	INT16	1	Analog Out	1 ... 16
Read Terminal Block Status Bit 0 = 1 ... No terminal block connected Bit 0 = 0 ... Terminal block connected properly Bit 1 = 1 ... Digital/Analog converter in operation (RUN LED lit) Bit 1 = 0 ... Digital/Analog converter not in operation (RUN LED not lit)	tc_global	BYTE	1	Status In	0

10.2.6 Relationship between Number Value and Output Voltage

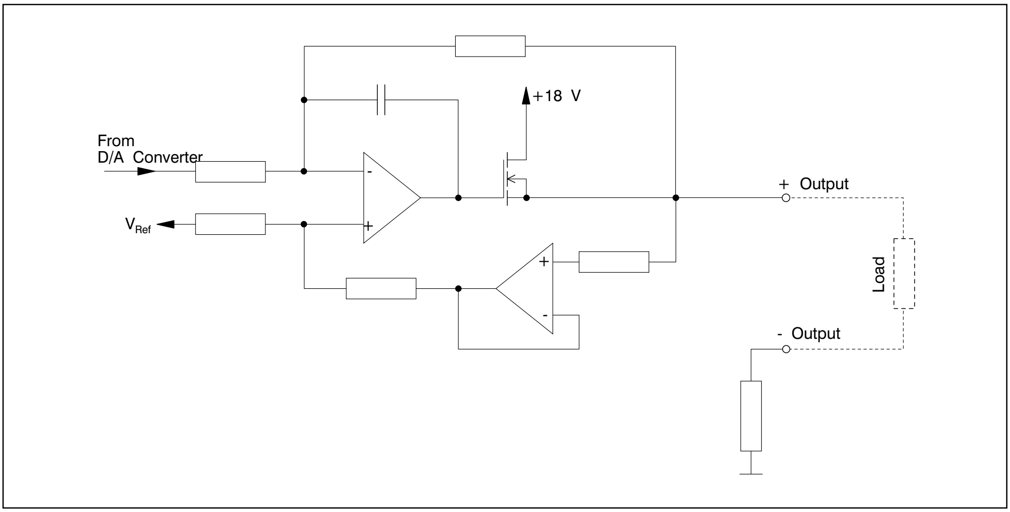
Number Value		Output Voltage
Hexadecimal	Decimal	
8000	-32768	-10 V
C000	-16384	-5 V
FFF0	-16	-4.88 mV
0000	0	0 V
0010	16	4.88 mV
4000	16384	5 V
7FF0	32752	10 V

10.3 AO725

10.3.1 Technical Data

Module ID	AO725
Model Number	2AO725.6
Description	2010 Analog Output Module, 8 outputs, 0 to 20 mA, 12 Bit, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$0F
Base Plate Module	BP200, BP201, BP210
Number of Outputs	8 current outputs (unipolar)
Electrical Isolation Output - PCC Output - Output	 Yes No
Output Signal	0 to 20 mA
Resolution	12 Bit
Conversion Time for all Channels	250 µsec
Output Filter	Cutoff frequency: 1 kHz
Load	Max. 600Ω
Precision Basic precision (at 20 °C) Precision (0 to 60 °C)	 ±0.5 % ±0.75 %
Short Circuit Protection	Yes
Power Consumption	Max. 10 W
Dimensions (H, W, D) [mm]	285, 40, 185

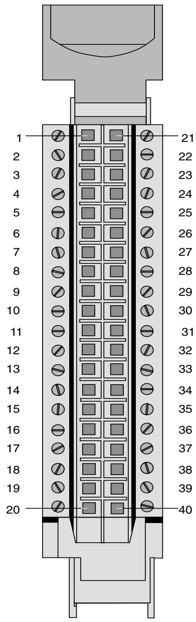
10.3.2 Output Circuit



10.3.3 Status LEDs

—< ●—	Indicates the status of the terminal block. i.e. if this LED is lit, either there is no terminal block connected or the terminal block is improperly connected. If the terminal block is not connected, (—< ●— is lit), all outputs are turned off and held to 0 V.
RUN	Indicates that the analog outputs are operating and the terminal is inserted. The RUN LED goes out if the terminal block is removed.

10.3.4 Terminal Assignments



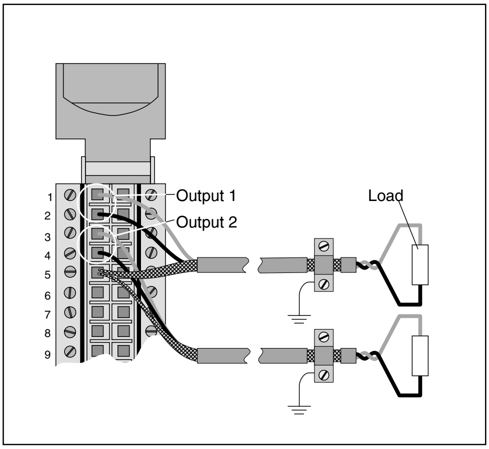
TB140

Terminal	Description	Terminal	Description
1	+ Output 1	21	----
2	- Output 1	22	----
3	+ Output 2	23	----
4	- Output 2	24	----
5	Shield	25	----
6	+ Output 3	26	----
7	- Output 3	27	----
8	+ Output 4	28	----
9	- Output 4	29	----
10	Shield	30	----
11	+ Output 5	31	----
12	- Output 5	32	----
13	+ Output 6	33	----
14	- Output 6	34	----
15	Shield	35	----
16	+ Output 7	36	----
17	- Output 7	37	----
18	+ Output 8	38	----
19	- Output 8	39	----
20	Shield	40	----

Connecting the Signal cable

Shielded cables must be used for analog output modules. The shielding is done for two outputs at a time and connected to the provided grounding clamps.

The four shielding connections are connected directly to ground (⏚,i.e.: spring contact and mounting rail).



10.3.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Output (Channel x)	tc_global	INT16	1	Analog Out	1 ... 8
Read Terminal Block Status Bit 0 = 1 ... No terminal block connected Bit 0 = 0 ... Terminal block connected properly Bit 1 = 1 ... Digital/Analog converter in operation (RUN LED lit) Bit 1 = 0 ... Digital/Analog converter in not operation (RUN LED not lit)	tc_global	BYTE	1	Status In	0

10.3.6 Relationship between Number Value and Output Current

Number Value		Output Current
Hexadecimal	Decimal	
0000	0	0 A
0008	8	4.88 µA
4000	16384	10 mA
7FF8	32760	20 mA

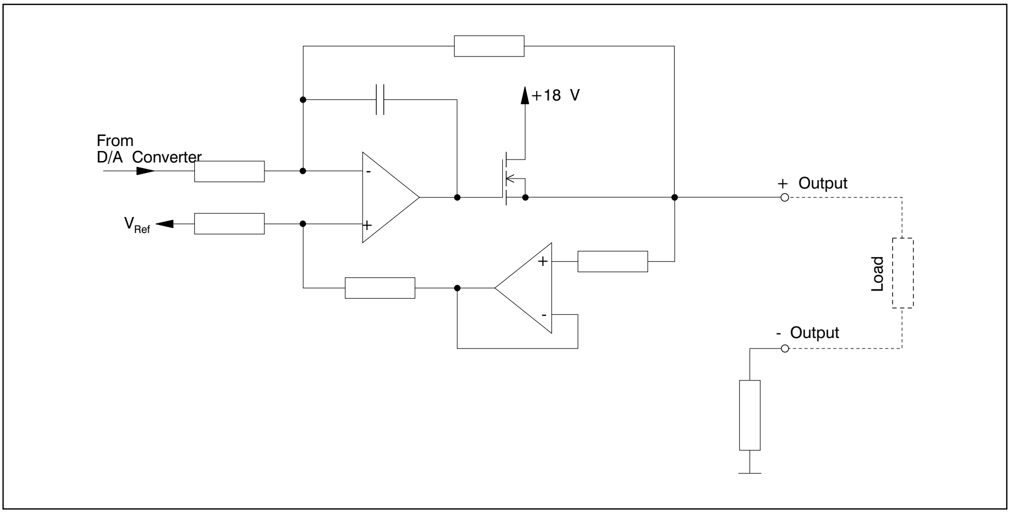
10.4 AO900

10.4.1 Technical Data

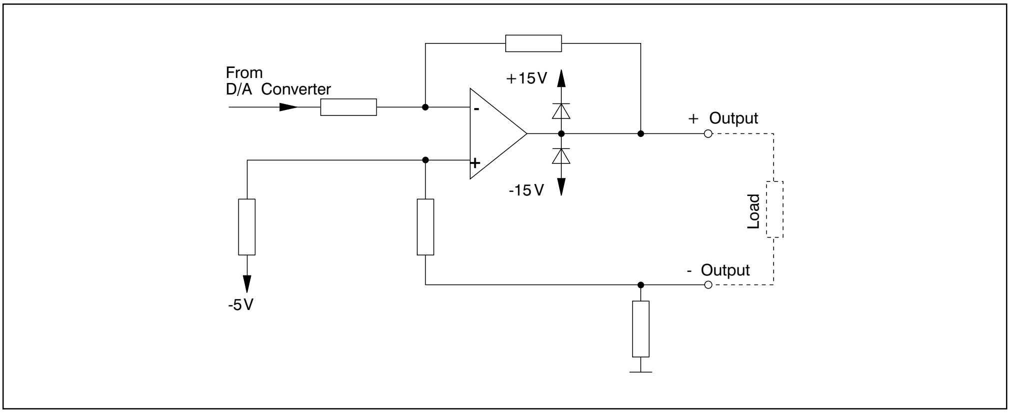
Module ID	AO900	
Model Number	2AO900.6	
Description	2010 Analog Output Module, 8 outputs, +/- 10 V, 12 Bit, 8 outputs, 0 to 20 mA, 12 Bit, Order terminal blocks separately!	
C-UL-US Listed	Yes	
B&R ID Code	$10	
Base Plate Module	BP200, BP201, BP210	
Number of Outputs	8 voltage outputs	8 current outputs
Electrical Isolation Output - PCC Output - Output	 Yes No	
Output Signal	-10 to +10 V	0 to 20 mA
Resolution	12 Bit	
Conversion Time for all Channels	250 µsec	
Output Filter	Cutoff frequency: 1 kHz	
Max. Load per Output	±10 mA (load ≥ 1 kΩ)	----
Short Circuit Protection (current limit)	Max. ±15 mA	----
Load	----	max. 600Ω
Precision Basic Precision (at 20 °C) Precision (0 to 60 °C)	 ±0.25 % ±0.5 %	 ±0.5 % ±0.75 %
Power Consumption	Max. 12 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

10.4.2 Output Circuits

Current Output



Voltage Output

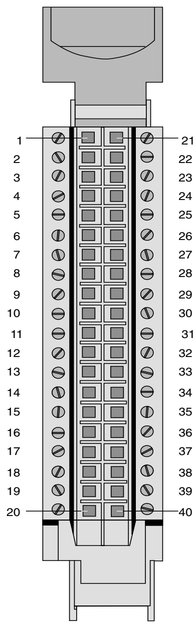


10.4.3 Status LEDs

—(●— Indicates the status of the terminal block. i.e. if this LED is lit, either there is no terminal block connected or the terminal block is improperly connected. If the terminal block is not connected, (—(●— is lit), all outputs are turned off and held to 0 V.

RUN Indicates that the analog outputs are operating and the terminal is inserted. The RUN LED goes out if the terminal block is removed.

10.4.4 Terminal Assignments



TB140

Terminal	Current Outputs	Terminal	Voltage Outputs
1	+ Output 1	21	+ Output 9
2	- Output 1	22	- Output 9
3	+ Output 2	23	+ Output 10
4	- Output 2	24	- Output 10
5	Shield	25	Shield
6	+ Output 3	26	+ Output 11
7	- Output 3	27	- Output 11
8	+ Output 4	28	+ Output 12
9	- Output 4	29	- Output 12
10	Shield	30	Shield
11	+ Output 5	31	+ Output 13
12	- Output 5	32	- Output 13
13	+ Output 6	33	+ Output 14
14	- Output 6	34	- Output 14
15	Shield	35	Shield
16	+ Output 7	36	+ Output 15
17	- Output 7	37	- Output 15
18	+ Output 8	38	+ Output 16
19	- Output 8	39	- Output 16
20	Shield	40	Shield

Connecting the Signal Cable

Shielded cable must be used for analog output modules. The connection is made exactly the same as for modules AO300 and AO725.

10.4.5 Variable Declaration

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single Analog Output (Channel x) Current Outputs Voltage Outputs	tc_global	INT16	1	Analog Out	1 ... 16 1 ... 8 9 ... 16
Terminal Block Status Bit 0 = 1 ... No terminal block connected Bit 0 = 0 ... Terminal Block connected properly Bit 1 = 1 ... Digital/Analog converter in operation (RUN LED lit) Bit 1 = 0 ... Digital/Analog converter not in operation (RUN LED not lit)	tc_global	BYTE	1	Status In	0

10.4.6 Relationship between Number Value and Output Current/Output Voltage

Number Value		Output Current	Output Voltage
Hexadecimal	Decimal		
8000	-32768	0 A	-10 V
C000	-16384	0 A	-5 V
FFF0	-16	0 A	-4.88 mV
0000	0	0 A	0 V
0008	8	4.88 µA	0 V
0010	16	9.76 µA	4.88 mV
4000	16384	10 mA	5 V
7FF0	32752	19.995 mA	10 V
7FF8	32760	20 mA	10 V

11 UNIVERSAL MIXED MODULE - UM900

11.1 GENERAL INFORMATION

The universal mixed module is a combination of digital I/O modules and analog I/Omodules.
The status of digital I/O points are indicated using Status LEDs. A Status LED labeled "RUN" shows if D/A and A/D conversion is running.

11.2 TECHNICAL DATA

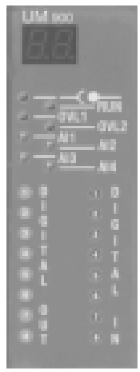
Module ID	UM900
Model Number	2UM900.6
Description	2010 Universal Mixed Module, 8 inputs, 24 VDC, 1 msec, 8 transistor outputs, 24 VDC, 0.5 A, 4 inputs, +/- 10 V, 12 Bit, 4 inputs, 0 to 20 mA, 12 Bit, 2 outputs, +/- 10 V, 12 Bit, 2 outputs, 0 to 20 mA, 11 Bit, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$21
Base Plate Module	BP200, BP201, BP210
Inputs/Outputs	8 digital inputs 8 digital outputs 4 analog inputs 2 analog outputs
Electrical Isolation Input - PCC Output - PCC Group 1 - Group 2 Analog - Digital	 Yes Yes Yes Yes

Module ID	**UM900**	
Digital Inputs	8	
in 2 Groups of	4	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Input Resistance	4 kΩ	
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V	
Switching Delay log. 0 - log. 1 log. 1 - log. 0	 Typ. 1 msec / max. 1.2 msec Typ. 1 msec / max. 1.2 msec	
Input Current at Nominal Voltage	5 mA	
Maximum Peak Voltage	500 V for 50 µsec max. every 100 msec	
Connection	Sink	
Digital Outputs	8	
in 2 Group to	4	
Type	Transistor	
Switching Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC	
Continuous Current	0.5 A (simultaneousness 100 %)	
Leakage Current when Turned Off	0.3 mA	
Switching Delay log. 0 - log. 1 log. 1 - log. 0	 Typ. 5 µsec / max. 110 µsec Typ. 60 µsec / max. 100 µsec	
Switching Frequency (resistive load)	Max. 500 Hz	
Short Circuit and Overload Protection	Yes	
Starting after Overload Cutoff	Automatic within seconds (depending on module temperature)	
Short Circuit Current	0.75 to 1.5 A	
Protective Circuit Internal External	 Against overvoltage peaks up to 55 V (VDE 160) Against reverse polarity of the 24 V supply on the module Only if required (Surge)	
Reverse Voltage when Switching Off Inductive Loads	45 to 55 V	
Connection	Source	
Analog Inputs	4 (measurement range set with software)	
Input Signal Nominal Min./Max.	 -10 to +10 V -20 to +20 V	 0 to 20 mA -30 to +30 mA
Resolution	12 Bit	
Conversion Time for all Channels	≤1 msec	
Differential Input Resistance	Approx. 1 MΩ	----
Load	----	50Ω
Voltage Drop at 20 mA	----	1 V

Chapter 3
B&R 2010 Modules

Module ID	UM900	
Analog Inputs		
Input Filter	Cutoff frequency: 400 Hz	
Measurement Precision Basic Precision at 20 °C Precision (0 to 60 °C) Common Mode Rejection	 ±0.25 % ±0.5 % 40 dB / 50 Hz	 ±0.25 % ±0.375 % 40 dB / 50 Hz
Analog Outputs	2 (voltage / current according to connection)	
Output Signal	-10 to +10 V	0 to 20 mA
Resolution	12 Bit	11 Bit
Conversion Time for all Channels	≤1 msec	
Output Filter	Cutoff frequency: 1 kHz	
Maximum Load per Output	10 mA (load ≥ 1 kΩ)	----
Short Circuit Protection (current limit)	Max. ±15 mA	----
Load	----	max. 600Ω
Precision Basic Precision at 20 °C Precision (0 to 60 °C)	 ±0.25 % ±0.5 %	 ±0.5 % ±0.75 %
Power Consumption	Max. 8 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

11.3 STATUS LEDS



—< ●— Indicates the status of the terminal block. i.e. if this LED is lit, either there is no terminal block connected or the terminal block is improperly connected. If the terminal block is not connected, (—< ●— is lit), all outputs are turned off and held to 0 V.

RUN Indicates that the analog/digital converter is running and the module is being accessed via the I/O bus. The RUN LED goes out if the terminal block is removed.

OVL1/2 Overload: This LEDs indicates that the overload or short circuit cutoff is activated for the respective LED group. If e.g. LED OVL1 is lit, that means at least one of the digital outputs from 1 to 4 has been turned off (see section "Overload Protection for Digital Outputs").

AI1 ... AI4 These LEDs are lit if the respective analog input is set for current measurement (the measuring resistance is turned on).

1 ... 8 DIGITAL OUT: LEDs 1 to 8 show the logical state of the respective digital outputs.

1 ... 8 DIGITAL IN: LEDs 1 to 8 show the logical state of the respective digital inputs.

11.4 REMOVING POWER ON DIGITAL OUTPUTS

By removing the terminal block, the terminal block contacts of the output module is turned off. This prevents any wear on the contacts because the terminal block is always inserted or removed without power. The logical state is retained when the terminal block is removed, i.e. immediately after re-inserting the terminal block, the outputs can continue from where they left off.

11.5 OVERLOAD PROTECTION FOR DIGITAL OUTPUTS

The overload protection is activated in the following instances:

- ❍ Junction temperature exceeds the allowed limits (typ. 150 °C, min. 135 °C, Max. 175 °C).
  Causes: Short circuit, overload or high environmental temperature.
- ❍ The 24 V supply voltage (terminal block side) is less than typ. 13 V (min. 10 V, Max. 14.5 V)

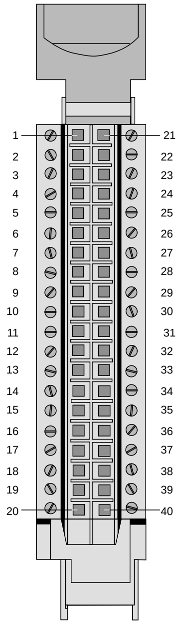
The affected output remains with the power off until ...

... the junction temperature is again within the allowed limits (hysteresis typ. 20 °C). This happens within seconds.

... the supply voltage is again within the allowed limits (typ. > 14.5 V).

... the terminal block is properly connected.

11.6 TERMINAL ASSIGNMENTS



TB140

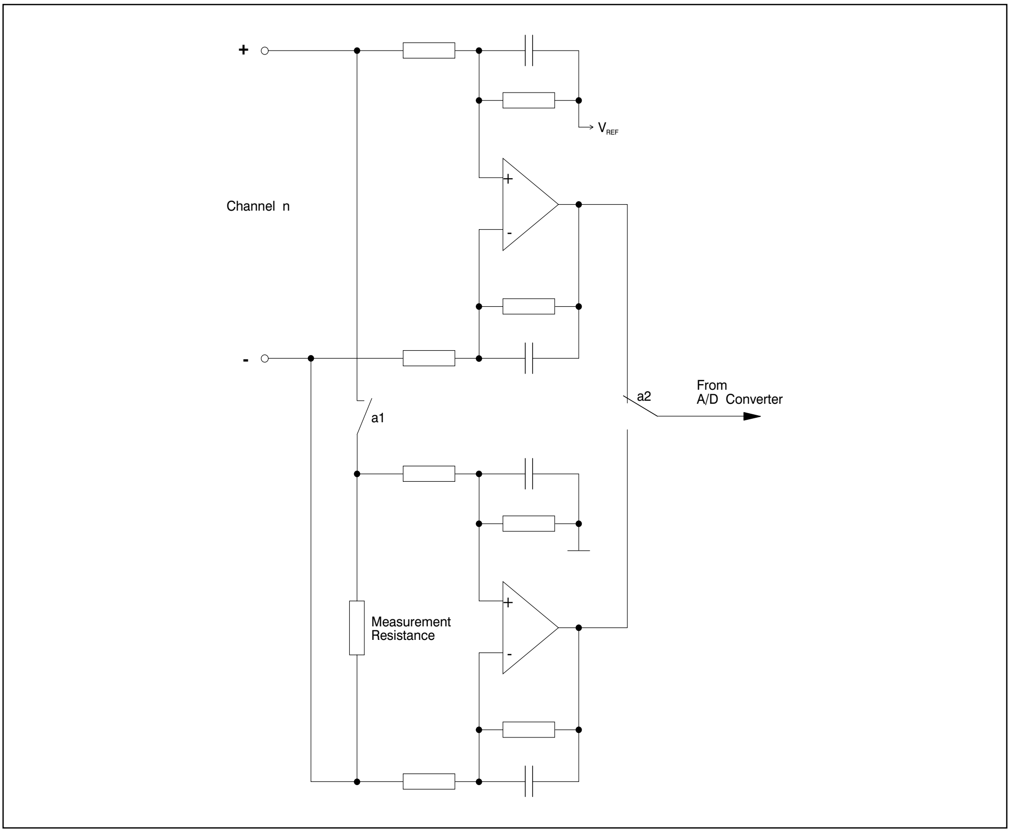
Terminal	Analog Inputs	Terminal	Analog Inputs
1	+ Input A1	21	+ Input A3
2	- Input A1	22	- Input A3
3	+ Input A2	23	+ Input A4
4	- Input A2	24	- Input A4
5	Shield	25	Shield
	Current Outputs		**Voltage Outputs**
6	+ Output I1	26	+ Output U1
7	- Output I1	27	- Output U1
8	+ Output I2	28	+ Output U2
9	- Output I2	29	- Output U2
10	Shield	30	Shield
	Digital Inputs/Outputs Group 1		**Digital Inputs/Outputs** Group 2
11	Input D1	31	Input D5
12	Input D2	32	Input D6
13	Input D3	33	Input D7
14	Input D4	34	Input D8
15	+24 V (1)	35	+24 V (2)
16	Output D1	36	Output D5
17	Output D2	37	Output D6
18	Output D3	38	Output D7
19	Output D4	39	Output D8
20	GND1 / COM1	40	GND2 / COM2

Connecting the Signal Cable

Shielded cable must be used for analog output modules. The connection is made exactly the same as for modules AO300 and AO725.

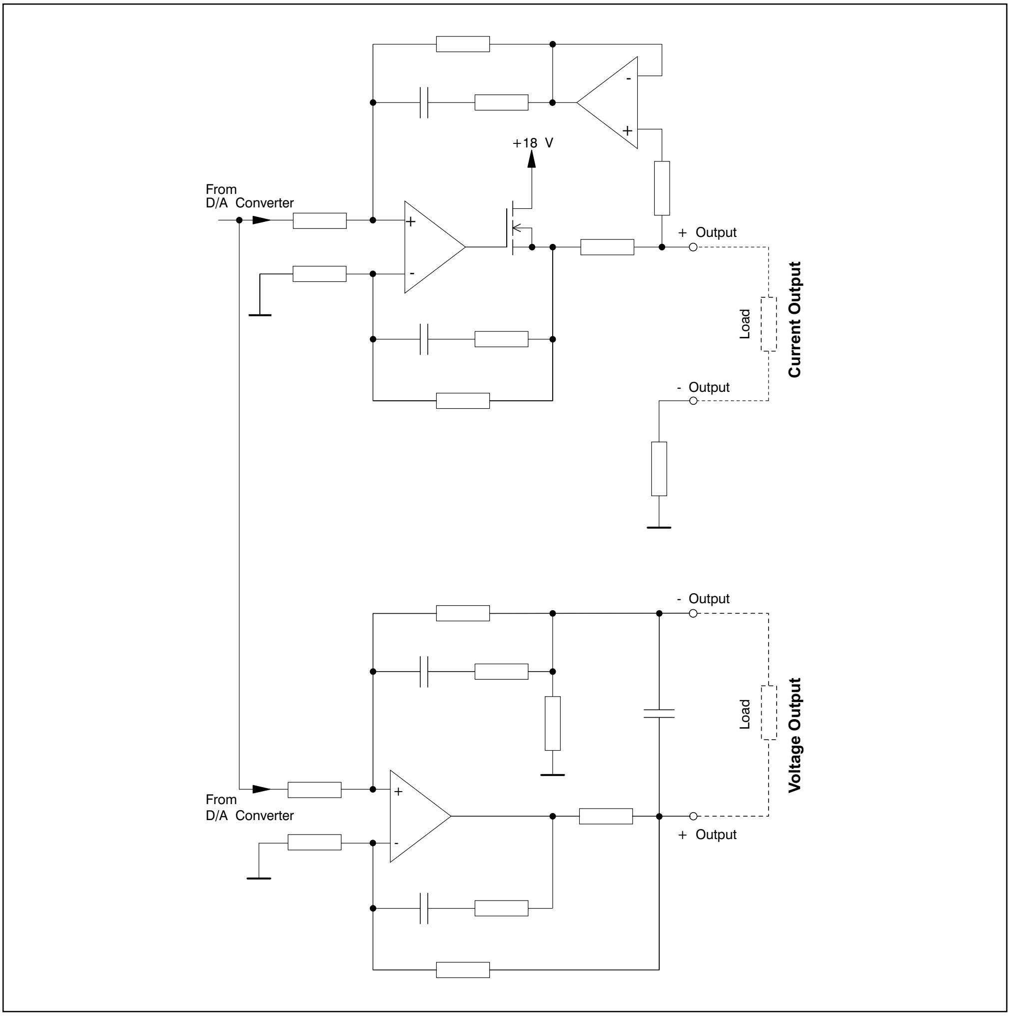
11.7 ANALOG INPUTS

The measurement range for the analog inputs can be set with a configuration register in the status area. Two bits are reserved for each channel. One bit switches on the shunt resistance (50 Ω) for each relay. The second bit changes the measurement range (also see section "Configuration Register").



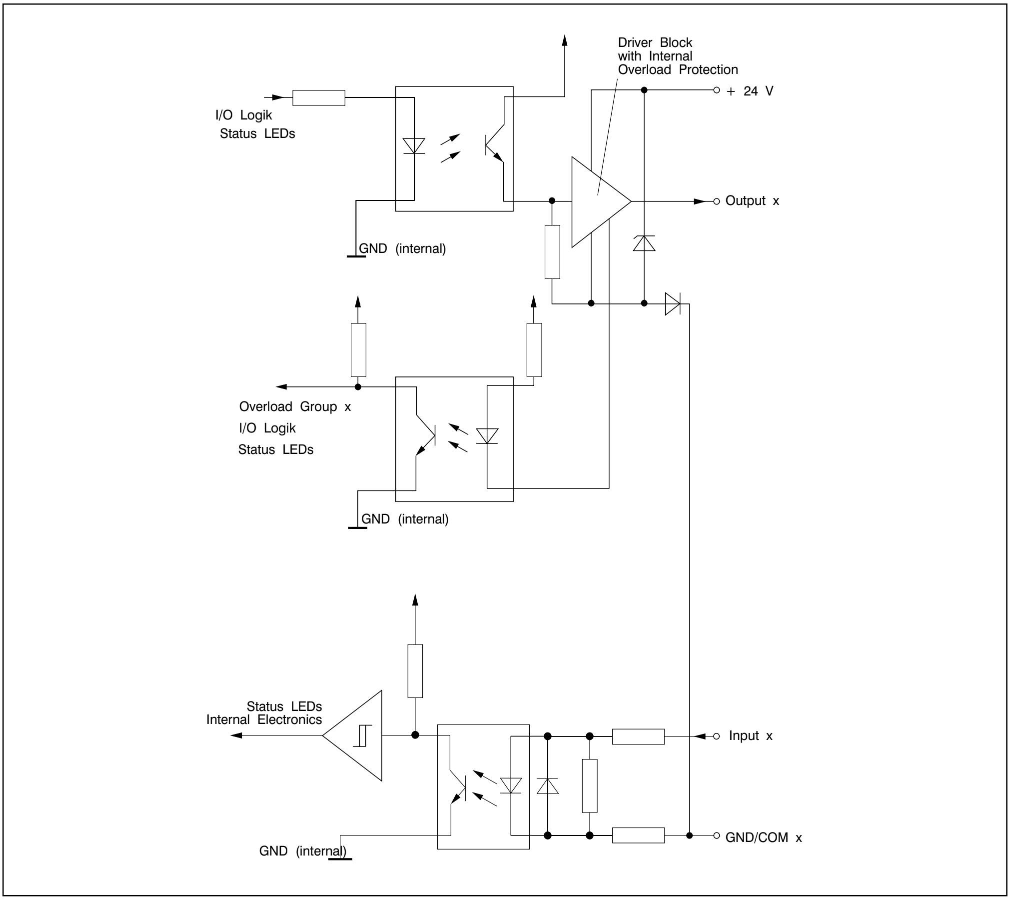
11.8 ANALOG OUTPUTS

Two analog outputs are available, whereas each channel is available on the terminal block as current and voltage output. If analog output 1 is written to by the CPU, the output voltage (Output U1) and output current (Output I1) change to correspond to the value written.



11.9 DIGITAL INPUTS/OUTPUTS

The digital inputs/outputs are divided into two groups, whereas each group contains both inputs and outputs. The groups are electrically isolated from each other. Pin +24 V supplies the outputs with voltage. Pin GND / COM is used as the reference potential (supply) for the outputs and also as common for the inputs.



11.10 PROGRAMMING

The digital/analog I/O are addressed directly via their variable names in the application program. The relationship between the I/O on a certain module and the variable names is defined in the variable declaration. The declaration is made exactly the same way for every programming language using a table editor.

11.11 VARIABLE DECLARATION

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Read Single Digital Input (Channel x)	tc_global	BIT	1	Digit. In	129 ... 136
Read Digital Inputs as Byte Bit 0 ... DIN 1 Bit 7 ... DIN 8	tc_global	BYTE	1	Transp. In	16
Single Digital Output (Channel x)	tc_global	BIT	1	Digit. Out	129 ... 136
Digital Outputs as Byte Bit 0 ... DOUT 1 Bit 7 ... DOUT 8	tc_global	BYTE	1	Transp. Out	16
Single Analog Input (Channel x)	tc_global	INT16	1	Analog In	1 ... 4
Single Analog Output (Channel x)	tc_global	INT16	1	Analog Out	1 ... 2
Read Status Register	tc_global	BYTE	1	Status In	0
Change Measurement Range by Writing to the Configuration Register	tc_global	BYTE	1	Status Out	1

Status Register

REGISTER READ	Bit	Description
	7	AI4 - Additional information
	6	AI3
	5	AI2
	4	AI1
	3	OVL2 - Overload in digital group 2 (DOUT 5 - 8)
	2	OVL1 - Overload in digital group 1 (DOUT 1 - 4)
	1	RUN - Analog section
	0	FKL - Terminal block status

7 0

AIx The additional information contains the settings for the four analog inputs.

0 ..... High resistance input (voltage measurement)
1 ..... 50Ω - Input (current measurement)

OVL2 Overload in digital group 2 (DOUT 5 - 8).

0 ..... OK
1 ..... Overload

OVL1 Overload in digital group 1 (DOUT 1 - 4).

0 ..... OK
1 ..... Overload

RUN Status of the analog section.

0 ..... Not active
1 ..... Active

FKL 0 ..... Terminal block is connected properly.
1 ..... No terminal block connected.

Configuration Register

REGISTER WRITE	Bit	Description
	7	ANI4 - Change measurement range for channel 4
	6	ANI4
	5	ANI3 - Change measurement range for channel 3
	4	ANI3
	3	ANI2 - Change measurement range for channel 2
	2	ANI2
	1	ANI1 - Change measurement range for channel 1
	0	ANI1

7 0

ANI4 00 ...... ±10 V (default)
11 ...... 0 to 20 mA

ANI2 00 ...... ±10 V (default)
11 ...... 0 to 20 mA

ANI3 00 ...... ±10 V (default)
11 ...... 0 to 20 mA

ANI1 00 ...... ±10 V (default)
11 ...... 0 to 20 mA

Settings 01 or 10 are not allowed!

11.12 RELATIONSHIP BETWEEN INPUT VOLTAGE/INPUT CURRENT AND CONVERTER VALUE

The converter value (INT16 format) changes in steps of 16 (..., -16, 0, 16, 32, ...).

Converter Value			
Hexadecimal	Decimal	Input Current	Input Voltage
8000	-32768	----	≤ -10 V
FFF0	-16	----	-4.88 mV
0000	0	0 A	0 V
0010	16	9.766 µA	4.88 mV
7FF0	32752	≥ 20 mA	≥ 10 V

11.13 RELATIONSHIP BETWEEN NUMBER VALUE AND OUTPUT CURRENT/OUTPUT VOLTAGE

Number Value			
Hexadecimal	Decimal	Output Current	Output Voltage
8000	-32768	0 A	-10 V
C000	-16384	0 A	-5 V
FFF0	-16	0 A	-4.88 mV
0000	0	0 A	0 V
0008	8	0 A	0 V
0010	16	9.76 µA	4.88 mV
4000	16384	10 mA	5 V
7FF0	32752	20 mA	10 V
7FF8	32760	20 mA	10 V

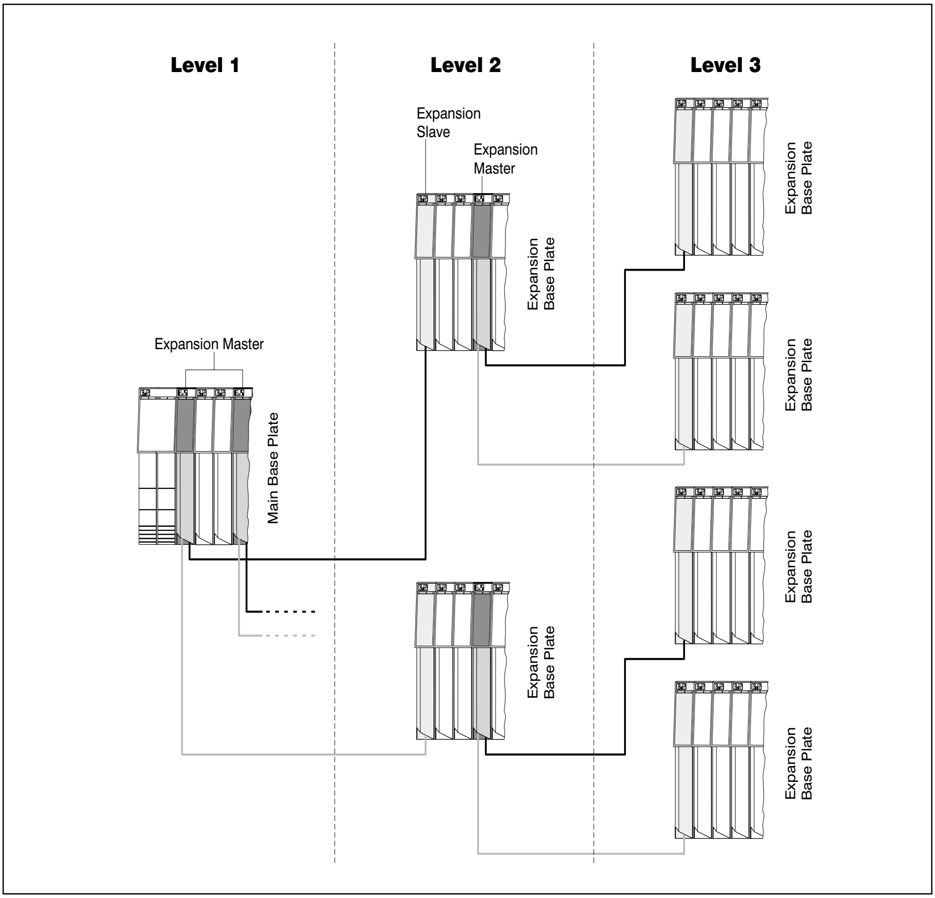
12 I/O BUS EXPANSION MODULE

12.1 GENERAL INFORMATION

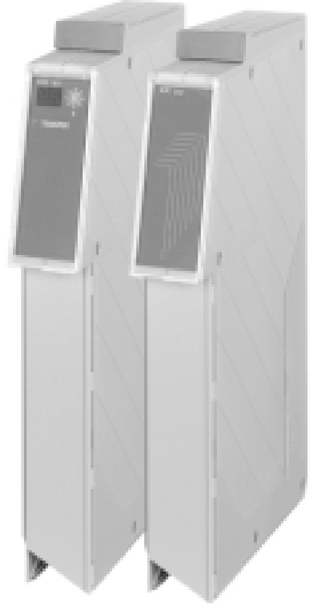
It is possible to address up to 99 I/O modules on a 2010 I/O bus. However, since a maximum of 20 I/O modules are allowed in any single row and 99 modules in a row would cause problems regarding space anyway (I/O bus 4 meters longer), the I/O bus can be split up into segments with an expansion master and expansion slave modules. The I/O bus can be divided into a maximum of 10 bus segments. This allows a maximum of 99 modules to be addressed from a single CPU (see Chapter "Planning and Installation" section "System Configuration and Power Supply").

For dividing the I/O bus into bus segments, the following should be checked:

- ❍ An Expansion Master can be operated in any slot on the bus segments situated in levels 1 and 2 (see diagram):
- ❍ The Expansion Slave is always located in the left-most slot of a bus segment.
- ❍ An extra base plate module (BP202) is required for the Expansion Slave.



12.2 TECHNICAL DATA



Module ID	**EX301** **Expansion Slave**	**EX302** **Expansion Master**
Model Number	2EX301.5	2EX302.5
Description	2010 Expansion Slave, I/O bus divided into segments, Order expansion cable separately!	2010 Expansion Master, I/O bus divided into segments, Order expansion cable separately!
C-UL-US Listed	Yes	Yes
B&R ID Code	$18	$19
Module Type	I/O module	I/O module
Base plate Module	BP202	BP200, BP201, BP210
Interfaces	1 (to connect an expansion master)	2 (to connect two expansion slaves)
Transfer Media 1 m 2 m	Expansion cable Model number: 0G0010.00-090 Model number: 0G0012.00-090	
Power Consumption	Max. 3 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

12.3 STATUS LEDS EX302

The EX302 module is not equipped with operating elements or diagnosis elements (no Status LEDs).

12.4 STATUS LEDS EX301

TRANSFER This LED indicates that data is being transferred either to or from an expansion master.

12.5 NUMBER SWITCH

The 10s position module address of the expansion slave is set with a BCD number dial. The numbering of I/O module addresses starts with the set number. The address is set in sets of 10 (10, 20, ... 90). Please ensure that bus segment addressing does not overlap. The start address of the bus segment is shown on a 7 segment display.

12.6 CABLING

Information on connecting the expansion master and its expansion slaves, setting the module address and the placing of power supply modules on the bus segments can be found in Chapter “Planning and Installation” in section “System Configuration and Power Supply”.

13 REMOTE MODULES

13.1 GENERAL INFORMATION

With **Remote Modules**, I/O modules which are situated at greater distances can be connected to the CPU. Up to 32 stations (1 Remote Master and 31 Remote Slaves) are connected with a bus cable (see Chapter "Planning and Installation" in section "System Configuration and Power Supply"). A new I/O bus begins with every Remote Slave, on which a maximum of 99 I/O modules can be addressed.

Pay attention to the following:

- ❍ The Remote Master is a system module and therefore must be situated left of the CPU on the system bus. The module address is set with the number switch.
- ❍ The Remote Slave is always located in the left-most slot of a bus segment.
- ❍ A separate special base plate module (BP202) is required for the Remote Slave.

13.2 TECHNICAL DATA

Module ID	EX100 Remote Master	EX200 Remote Slave
Model Number	2EX100.50-1	2EX200.50-1
Description	2010 Remote I/O Master, 2 elect. isolated RS485 interface for Connection to Remote I/O Bus	2010 Remote I/O Slave, 2 elect. isolated RS485 interface for Connection to Remote I/O Bus
C-UL-US Listed	Yes	Yes
B&R ID Code	$01	----
Module Type	System module	I/O module
Base Plate Module	BP101, BP110	BP202
Serial Interface	2 x RS485	
Type	2 x 9 pin D-type sockets	
Electrical Isolation	Yes	
Baudrates	Depends on distance	
100 kBit/sec	Max. 1200 m	
181 kBit/sec	Max. 1000 m	
500 kBit/sec	Max. 400 m	
1000 kBit/sec	Max. 200 m	
2000 kBit/sec	Max. 100 m	
Remote I/O Bus		
Max. Number of Remote I/O Masters on the System Bus	8	----
Number of Slaves	Max. 31 (without repeater)	----
Access	Master/slave principle	
Topology	Physical bus	
Connection to the Bus	Direct	
Transfer Media	Shielded, twisted pair	
Termination Resistance	External	
Diagnosis LED	Yes	

Module ID	EX100 Remote Master	EX200 Remote Slave
Number Switch	Module address setting	----
NODE#	Slave address setting	
Power Consumption	Max. 12 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

13.3 HARDWARE ERROR

RUN Remote module is in operation

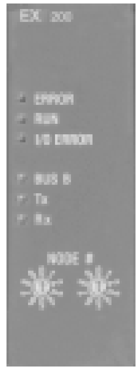
I/O ERROR An error occurred during I/O data transfer

BUS B This LED has no function at this time

Tx Data is being transmitted

Rx Data is being received

Remote Master



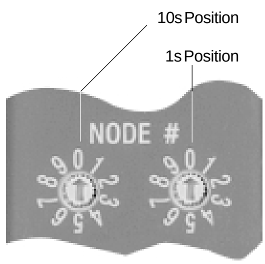
Remote Slave

13.4 NUMBER SWITCH

Remote Master / Module Address

The module address of the remote master on the system bus is set using the number dial. The installed address is shown on the 7 segment display. Please ensure that no address is used twice on the system bus.

Remote Slave / Slave Address



The slave address of the remote master or slave is set using the number dial. The remote slave is always in the left-most slot of the I/O bus. Communication with the slave is carried out using this address. The I/O module addresses on the bus carry on from here.

Dynamic addressing is activated by using the slave address 99. This address selection forces the remote slave to read its address from the first I/O module (digital input module) of the remote station. The first eight digital inputs of the module are interpreted as a binary number and installed as the address.

Intelligent Slave

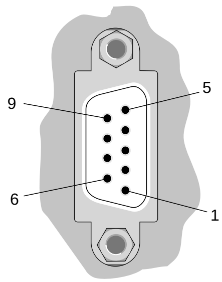
An intelligent slave (ISL) is an RIO slave with its own CPU. The ISL CPU can make calculations or prepare data before it is sent to the master. This data does not have to be inputs or outputs. Internal variables in the ISL CPU are also possible.
Using ISLs greatly reduces the load on the master CPU. ISL CPUs are complete CPU modules (B&R 2005 or B&R 2010) with the same task class system. They can run nearly independent from the master CPU and only send responses to the master as required.

Hardware: The RIO master remains unchanged (B&R 2005 or B&R 2010). The hardware configuration for the intelligent slave is the same as for a masters: RIO master module (EX100), CPU and I/O. Physically, it is a two master System. The connection is made in the same way as a "normal" master/slave system.

Number Switch: Because this module is a system module, the module address must be set (see "Remote Master/Module Address").
The slave address is set with the two number switches labelled NODE# (see "Remote Slave/Slave Address). Dynamic addressing does not functions on the ISL!

13.5 RS485 - INTERFACES

Two electrically isolated RS485 interfaces are located behind the module door.



9 Pin D-Type Connector (F)

Pin	Desc.	Function
1	Shield	
2		
3	DATA	
4	CNTRL	Transmit Enable
5	GND	Electrically isolated supply
6	+5 V / 200 mA	Electrically isolated supply
7		
8	$\overline{\text{DATA}}$	
9	$\overline{\text{CNTRL}}$	$\overline{\text{Transmit Enable}}$

The lower interface is used for normal operation of a remote system. The module is for redundant operation, whereas the upper interface is used to construct a second network.

13.6 CABLING A REMOTE SYSTEM

Information concerning specifications for the bus cable and the connections can be found in Chapter 2 "Planning and Installation" in section "System Configuration and Power Supply" (Remote I/O Bus).

13.7 SETTING UP A REMOTE SYSTEM

Procedures for setting up a Remote System:

1) Cable the entire Remote Systems (see chapter “Planning and Installation” in section “System Configuration and Power Supply”).

2) Attach termination resistors at the beginning and the end of the Remote Bus (especially with higher baudrates, the bus termination placing must be properly done!).

3) Set all slave addresses (no doubled addresses; 0 may not be used; address 99 activates dynamic addressing).

4) Switch on all stations. The slaves automatically accept the baudrate of the master at power-on. The switch-on sequence is not important for boot behavior or functionality!

Selecting or setting the baudrate is done in the CPU with the PG2000 utility program PCC Configurator (see “B&R 2000 Software User's Manual” Chapter “PCC Configurator”). 500 kBaud is set as default during manufacture.

Automatic Baudrate Recognition

❍ All Slaves are equipped with automatic baudrate recognition.

❍ If a Remote Slave is switched on, which is not connected to the Remote Bus, the LEDs **Run** and **I/O Error** begin blinking. This only means that the slave is trying to determine the baudrate of the master.

❍ If the slave is connected to the master with the bus cable, the **Run** and **I/O Error** LEDs switch off automatically as soon as the slave recognizes the baudrate of the master (to recognize the baudrate, all telegrams on the Remote Bus are evaluated).

❍ If the slave doesn't receive the baudrate telegram from the master after a certain period of time, it switches back to automatic baudrate recognition (the same as after a Power On).

14 PROFIBUS NETWORK MODULE - NW100

14.1 GENERAL INFORMATION

The PROFIBUS network is used for communication between PROFIBUS capable I/O components such as PCC components, control panels and industrial PCs (e.g.: PROVIT form B&R).

14.2 TECHNICAL DATA

Module ID	NW100
Model Number	2NW100.50-1
Description	2010 PROFIBUS Network Module, 2 elect. isolated RS485 interface for connection to a PROFIBUS network
C-UL-US Listed	Yes
B&R ID Code	$10
Module Type	B&R 2010 system module
Base Plate Module	BP101, BP110
Serial Interface Type Electrical Isolation Baudrates 9.6 kBit/sec 19.2 kBit/sec 93.75 kBit/sec 187.5 kBit/sec 500 kBit/sec	2 x RS485 2 x 9 pin D-type socket Yes Depending on distance Max. 1200 m Max. 1200 m Max. 1200 m Max. 1000 m Max. 400 m

Module ID	NW100
PROFIBUS Data Transfer Protocol Access Number of Stations Topology Connection to the Bus Transfer Media	 PROFIBUS standard, DIN 19245 parts 1 and 2 Token passing principle with underlying master/slave principle Max. 127 (with repeater) Physical bus Direct Shielded, twisted pair
Diagnosis LEDs	Yes
Number Switch	Four - module address, station address and baudrate setting
Power Consumption	Max. 15 W
Dimensions (H, W, D) [mm]	285, 40, 185

14.3 STATUS LEDs

ERROR Error

RUN Network processor initialized by the PCC CPU.

CONNECT At least one connection has been established.

COMM Connection established and PROFIBUS transaction occurring.

BUS B This LED has no function at this time.

Tx Data is being sent through the RS485 interface.

Rx Data is being received through the RS485 interface.

14.4 OPERATION

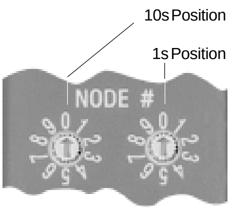
The NW100 PROFIBUS module is operated by means of software which can be obtained from B&R.

14.5 NUMBER SWITCH

Module Address

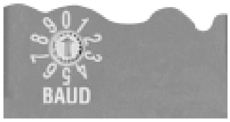
The module address of the network module on the system bus is set with the number switch. The module address is shown on a 7 segment display. Ensure that no two system modules are assigned with the same address.

Station Address



The remote slave address is set using these number dials. Communication with the slave is made through the address set here.

Baudrate



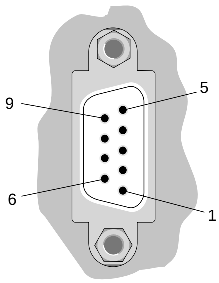
The baudrate for communication with PROFIBUS is set with the number switch which is named **BAUD**.

The following baudrates can be set:

Baudrate Switch	
Setting	**Baudrate**
0	9.6 kBit/sec
1	19.2 kBit/sec
2	93.75 kBit/sec
3	187.5 kBit/sec
4	500 kBit/sec

14.6 RS485 INTERFACES

Two electrically isolated RS485 interfaces are found behind the module door.



9 Pin D-Type Connector (F)

Pin	Desc.	Function
1	Shield	
2		
3	DATA	
4	CNTRL	Transmit Enable
5	GND	Electrically isolated supply
6	+5 V / 200 mA	Electrically isolated supply
7		
8	$\overline{\text{DATA}}$	
9	$\overline{\text{CNTRL}}$	$\overline{\text{Transmit Enable}}$

The lower interface is to be used for normal operation of PROFIBUS. The module is also able to run with redundant operation, whereas the upper interface is used for starting a second bus.

14.7 CABLING A PROFIBUS SYSTEM

The cabling for a PROFIBUS is also used for the remote bus. Information concerning specifications for the bus cable and the cabling can be found in Chapter 2 "Planning and Installation" in section "System Configuration and Power Supply" (Remote I/O Bus).

15 INTERFACE MODULES - IF100 AND IF101

15.1 GENERAL INFORMATION

Fundamentally, interface modules allow the PCC to exchange data with other devices (other PCCs). This is often necessary in complex applications if there not enough interfaces on the CPU.

15.2 TECHNICAL DATA

Module ID	**IF100**	**IF101**
Model Number	2IF100.60-1	2IF101.60-1
Description	2010 Interface Module, 64 + 404 KB SRAM, 256 KB FlashPROM, 1 RS232 interface, 1 elect. isolated RS232/TTY, 1 RS485/RS422 interface, elect. isolated, network capable, 1 CAN interface, elect. isolated, network capable	2010 Interface Module, 64 + 404 KB SRAM, 256 KB FlashPROM, 1 RS232 interface, 1 elect. isolated RS232/TTY, 1 RS485/RS422 interface, elect. isolated, network capable, 1 CAN interface, elect. isolated, network capable, 1 ETHERNET connection, BNC socket, elect. isolated, network capable
C-UL-US Listed	Yes	Yes
B&R ID Code	$2E	$2E
User RAM	404 KByte (not buffered)	
System RAM	108 KByte (not buffered)	
Dual Ported RAM	64 KByte (not buffered)	
PROM User PROM System PROM	 256 KByte FlashPROM 256 KByte FlashPROM	

Module ID	**IF100**	**IF101**
Number of Interfaces	4	5
Application Interface IF1		
Type	RS232	
Connector	9 pin D-type plug	
Electrical Isolation	No	
Controller	RISC (68302)	
Maximum Distance	15 m / 19200 Baud	
Maximum Baudrate	64 kBaud	
Bus Capable	No	
Application Interface IF2		
Type	RS232 / TTY	
Interface Selection	Using software	
Connector	9 pin D-type plug	
Electrical Isolation	Yes	
Controller	RISC (68302)	
Maximum Distance RS232 TTY	 15 m / 19200 Baud 300 m	
Maximum Baudrate RS232 TTY	 64 kBaud 64 kBaud	
Bus Capable	No	
Application Interface IF3		
Type	RS485 / RS422	
Interface Selection	Using software	
Connector	9 pin D-type socket	
Electrical Isolation	Yes	
Controller	RISC (68302)	
Maximum Distance	1200 m	
Maximum Baudrate	347 kBaud	
Bus Capable	Yes	
Bus Connection	T-connector (model number 0G1000.00-090)	
Application Interface IF4		
Type	CAN (Controller Area Network)	
Connector	9 pin D-type plug	
Electrical Isolation	Yes	
Controller	Intel Controller 82527	
Maximum Distance	1000 m	
Maximum Baudrate Bus Length 10 - 60 m Bus Length 100 - 200 m Bus Length 800 - 1000 m	 500 kBit/sec 250 kBit/sec 50 kBit/sec	
Bus Capable	Yes	
Bus Connection	T-connector (model number 7AC911.9)	

Module ID	IF100	IF101
Application Interface IF5		
Type		ETHERNET
Connector		10BASE2: CHEAPERNET BNC socket
Electrical Isolation		Yes
Controller		AM79C960
Maximum Baudrate		10 MBit/sec
Bus Capable		Yes
Bus Connection		Coax-T
Power Consumption	Max. 7 W	
Dimensions (H, W, D) [mm]	285, 40, 185	

15.3 STATUS-LEDs

ERROR Error or undefined state.

RUN The interface module was initialized by the PCC CPU.

READY The interface module is running without errors.

PGM This LED is lit if the FlashPROM is being programmed.

ACCESS This LED is lit if the interface module is accessing the CPU or other system modules via the system bus.

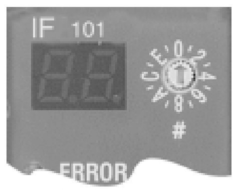
REMOTE I/O RIO interface is active.

CAN I/O CAN interface is active.

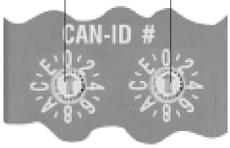
15.4 NUMBER SWITCH

Module Address

The module address of the interface module found on the system bus is set with the number switch. The module address is shown on the 7 segment display. Make sure that there is no other system module with the same module address.



CAN Node Number Dials



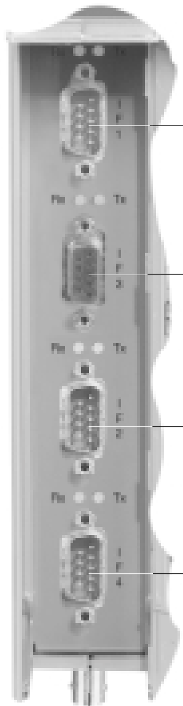
The Hex dials are used to set the CAN node number. The position of the dial can be evaluated by the application program. When the dial is turned during operation a relevant warning message is generated. The dial status can only be identified by the operating system during start up.
Positions 00 and FF are reserved for special functions.

Dial Position:	00 ...	Boot manager enabled
	FF ...	Diagnosis Mode

15.5 CONNECTIONS

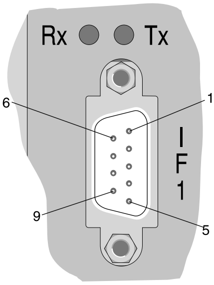
The interface connections can be found behind the module door.

The Status LEDs above the interfaces indicate if data is being transmitted (Tx) or received (Rx).



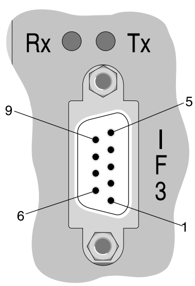
15.6 APPLICATION INTERFACE (IF1)

The non-electrically isolated RS232 interface is suitable for connection via a fibre optics cable. The fibre optics cable is supplied with the 4.8 V supply voltage (pin 4 of the D-type plug).
LEDs above the interface indicate if data is being transmitted (Tx) or received (Rx). IF1 is modem capable.

Interface	Pin Assignments		
RS232		**RS232**	
	1	NC	
	2	RXD	Receive Signal
	3	TXD	Transmit Signal
	4	DTR	Data Terminal Ready (+4,8 V / 150 mA)
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
9 Pin D-type Connector (M)	9	NC	

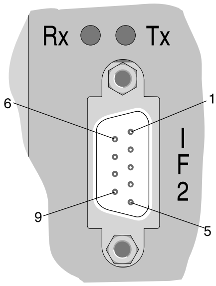
15.7 APPLICATION INTERFACE (IF3)

The electrically isolated IF3 can be used as RS422 or RS485 interface.
IF3 is suitable for connection via a fibre optics cable. The fibre optics cable is supplied with the electrically isolated 5 V supply voltage (pin 6 on the D-type socket).
LEDs above the interface indicate if data is being transmitted (Tx) or received (Rx).

Interface	Pin Assignments		
RS485/RS422		**RS485**	**RS422**
	1	Shield	Shield
	2	CTRL	TXD
	3	DATA	RXD
	4	CTRL	TXD
	5	GND	GND
	6	+ 5 V / 200 mA	+ 5 V / 200 mA
	7	$\overline{\text{CTRL}}$	$\overline{\text{TXD}}$
	8	$\overline{\text{DATA}}$	$\overline{\text{RXD}}$
9 Pin D-type Connector (F)	9	$\overline{\text{CTRL}}$	$\overline{\text{TXD}}$

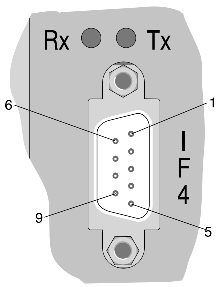
15.8 APPLICATION INTERFACE (IF2)

LEDs above the electrically isolated interface indicate if data is being transmitted (Tx) or received (Rx).

Interface	Pin Assignments		
RS232/TTY		**RS232**	**TTY**
	1	res.	TXD
	2	RXD	Current 1
	3	TXD	res.
	4	res.	RXD
	5	GND	GND
	6	res.	TXD Ret
	7	RTS	Current 2
	8	CTS	res.
9 Pin D-type Connector (M)	9	res.	RXD Ret

15.9 APPLICATION INTERFACE (IF4)

The two Status LEDs for transmit and receive above the D-type plug show the activity on the CAN bus between controller and optocoupler. The CAN interface is not electrically isolated.

Interface	Pin Assignments	
CAN		**CAN**
	1	NC
	2	CAN L
	3	GND
	4	NC
	5	NC
	6	res.
	7	CAN H
	8	NC
9 Pin D-type Connector (M)	9	NC

15.10 APPLICATION INTERFACE (IF5)

This interface is **only available on IF101**!

The IF5 is cabled as an ETHERNET interface. The connection is made with a 10BASE2 CHEAPERNET BNC plug (F) in the housing. A coax T connector is attached here.

16 INTELLIGENT I/O PROCESSORS

16.1 GENERAL INFORMATION

Intelligent I/O processors are programmable I/O modules. These intelligent I/O processors can be a single or double modules depending on their functionality. Currently there are several types of modules in B&R 2010 system available for the different areas of application. Each module has different functionality and hardware interfaces.

PG2000 user programs and data modules can be created for all intelligent I/O processors. Depending on the type of module, specific function blocks for special module functions are available. These function blocks are for defining certain hardware parameters which exist only on these intelligent modules.

A local processor kernel with RISC processor, local system RAM and operating system is common to all intelligent I/O processors. The communication interface between the PCC CPU and the intelligent I/O processor is the DPR range, which is divided into a data area and a status area. Variables can be stored in the data area. The PCC CPU and the local processor always have access to this data area, whereas the data consistency is defined for LONG and WORD data types. Larger data structures cannot be utilized.

The status area works in cooperation with the spooler and enables the transfer from B&R modules to the intelligent processors. User programs and/or data modules can be transferred to the desired I/O module from the application memory (APM) of the PCC CPU with the spooler during the controller boot-up. Parameter data can be transferred cyclically to the PCC CPU in both directions using function block calls.

16.1.1 Overview

Module	Description	Module width
DS100	Drum sequencer (only virtual outputs)	Single
DS101	Drum sequencer (32 direct transistor outputs)	Double
NC303	Ultrasonic transducer module	Double

16.2 DS100

16.2.1 General Information

The DS100 module is a programmable I/O module with 3 differential outputs and 16 digital inputs. This module is mainly used for **Electronic Drum Sequencers**.

The drum sequencer gets its name from the mechanical drum sequencers which works by means of cam on a shaft. Every disc represents a certain output which is active in certain positions during the rotation of the shaft.
The electronic functionality of the drum sequencer has the following advantages over the mechanical camshaft.:

- Higher switching precision
- Switching cycle does not cause wear
- Easier adjustment
- Pre-stop times

The DS100 I/O processor is used as a drum sequencer can calculate the output states of up to 128 outputs according to the actual angular position. In addition, a time can be calculated to compensate for switching times. The output states are stored in the DPR (Dual Port RAM) and can be read cyclically by the PCC CPU and recopied to any digital output modules.

To read the actual angular position, the following encoders can be hooked up to the differential inputs or outputs of the DS100 module:

- Absolute encoder with synchronous serial interface (SSI)
- Absolute encoder with parallel interface
- Incremental encoder

The method of coding (gray or dual) as well as the encoder resolution can be defined by the user with software (function block).
The encoder supply comes from the module as well. It is electrically isolated from the PCC, short circuit protected and current limited and is available on the terminal block.

The electronic drum sequencer can be configured by the user using function blocks. The respective software can be obtained from B&R (including documentation).

16.2.2 Technical Data

Module ID	DS100	
Model Number	2DS100.60-1	
Description	2010 Electronic Drum Sequencer, absolute encoder, SSI/parallel, 16 Bit, 3 differential inputs, RS422 level, 100 kHz, 3 differential outputs, RS422 level, 100 kHz, 16 digital inputs 24 VDC, 5 µsec, Sink, Order terminal blocks separately!	
C-UL-US Listed	Yes	
B&R ID Code	$1A	
Module Type	B&R 2010 I/O module	
Base Plate Module	BP200, BP201, BP210	
Communication	RISC processor	
Instruction Cycle Time	0.8 µsec	
Dual Ported RAM (DPR)	384 Byte SRAM (not buffered)	
System RAM	256 KByte SRAM (not buffered)	
Encoder Supply (internal)	Electrical isolation, short circuit protection and current limitation	
Encoder Supply Voltage	24 V ±10%	4.6 V ±10%
Load	Max. 120 mA	Max. 120 mA
Encoders Used		
Absolute Encoder (Single Turn) Coding Resolution	Synchronous serial interface (SSI) Gray or dual Max. 16 Bit (range: 4096 steps)	Parallel interface Gray or dual Max. 12 Bit
Differential Outputs		
Number of Differential Outputs	3	
Electrical Isolation Outpout - PCC Output - Output	Yes (optocoupler) No	

Module ID	DS100
Differential Outputs	
Output Level	RS422
Output Frequency	Max. 100 kHz
Differential Inputs	
Number of Differential Inputs	3
Electrical Isolation Input - PCC Input - Input	 Yes (optocoupler) No
Input Level	RS422
Input Frequency	Max. 100 kHz
Digital Inputs	
Number of Inputs Total 16 in Groups of	 4
Connection	Sink connection required (COM connections are to be connected to GND)
Electrical Isolation Input - PCC Group - Group Input - Input	 Yes (optocoupler) Yes (optocoupler) No
Input Voltage Nominal Maximal	 24 VDC 30 VDC
Input Resistance	4,4 kΩ
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V
Switching Delay log. 0 - log. 1 log. 1 - log. 0	(max. and typ.) 5 µsec (pulse width≥ 20 µsec) 5 µsec (pulse width≥ 20 µsec)
Count Frequency	Max. 25 kHz (ratio 1:1)
Power Consumption 24 V Encoder Supply Voltage 4.6 V Encoder Supply Voltage	 9 W + 1.5 x encoder power 9 W + 2.5 x encoder power
Dimensions (H, W, D) [mm]	285, 40, 185

16.2.3 Differential Outputs

If the DS100 module is used as an electronic drum sequencer, the differential outputs are to be used to connect an absolute encoder via a synchronous serial interface.
By installing the proper software, other functions (e.g. frequency inputs or pulse width modulation outputs) can also be can also be used. If digital inputs 9 to 16 are used, differential output 3 is no longer available for use.

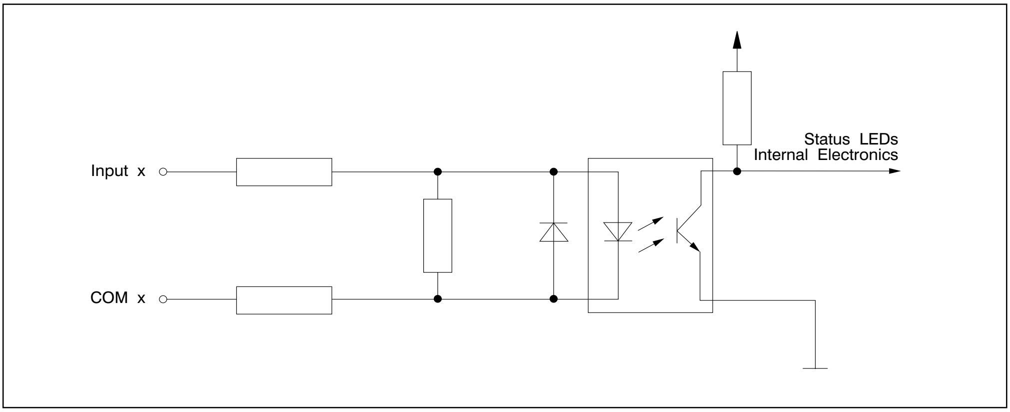
16.2.4 Differential Inputs

If the DS100 module is used as an electronic drum sequencer, the differential inputs are to be used to connect an absolute encoder via a synchronous serial interface.
By installing the proper software, the differential inputs can be used as pulse inputs or for gate time measurement for example.

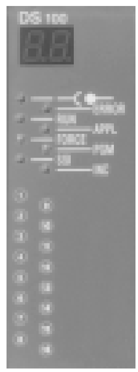
16.2.5 Digital Inputs

If the DS100 module is used as an electronic drum sequencer, the digital inputs are to be used to connect an absolute encoder via a parallel interface.
By installing the proper software, channels 1 to 8 can also be used as normal digital inputs, pulse inputs or for gate time measurement. However, channels 9 to 16 are only used as normal digital inputs.

Digital Input Circuit

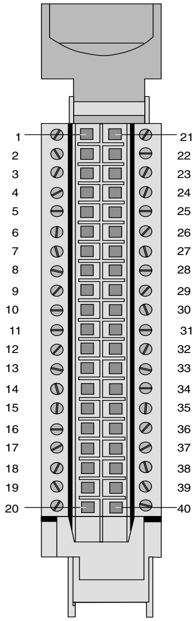


16.2.6 Status LEDs



—(●—	Indicates the terminal block status, i.e. if this LED is lit, the terminal block is not connected properly or there isn't one.
RUN	LED “RUN” light, if the intelligent I/O processor is in operation.
FORCE	EEPROM is used or original TPU code overload
SSI	This LED lights if an absolute encoder is connected with a synchronous serial interface (SSI) and delivers a signal.
ERROR	Error or undefined state.
APPL	The “APPL” LED lights if the application software is running.
PGM	The LED is lit if data is being exchanged between the PCC CPU and the intelligent I/O processor program.
INC	This LED has no function at this time (reserved for incremental encoders).
1 ... 16	LEDs 1 to 16 indicates the logical state of the respective digital input.

16.2.7 Terminal Assignments



TB140

Terminal	Description	Group	Terminal	Description	Group
1	RXD[1]		21	TXD[1]	
2	Shield		22	GND[1]	
3	24V ENCODER		23	GND ENCODER	
4	4.6V ENCODER		24	GND ENCODER	
5	Differential Output 1 +		25	Differential Output 1 -	
6	Differential Output 2 +		26	Differential Output 2 -	
7	Differential Output 3 +		27	Differential Output 3 -	
8	Differential Input 1 + / A[2]		28	Differential Input 1 - / $\overline{A}$[2]	
9	Differential Input 2 + / B[2]		29	Differential Input 2 - / $\overline{B}$[2]	
10	Differential Input 3 + / R[2]		30	Differential Input 3 - / $\overline{R}$[2]	
11	Digital Input 1	1	31	Digital Input 9	3
12	Digital Input 2		32	Digital Input 10	
13	Digital Input 3		33	Digital Input 11	
14	Digital Input 4		34	Digital Input 12	
15	COM (1-4)		35	COM (9-12)	
16	Digital Input 5	2	36	Digital Input 13	4
17	Digital Input 6		37	Digital Input 14	
18	Digital Input 7		38	Digital Input 15	
19	Digital Input 8		39	Digital Input 16	
20	COM (5-8)		40	COM (13-16)	

1) RS232 connection for VT100 terminal (in order to be able to work with IP Monitor). If terminals are not connected, connections 1 and 21 are to be jumped by the user.

2) Incremental encoder

16.2.8 Encoder Connection

The following encoders can be connected to the DS100 module:

- ❍ Absolute encoder with synchronous serial interface (SSI)
- ❍ Absolute encoder with parallel interface
- ❍ Incremental encoder

	Absolute encoder with syn. serial interface		Absolute encoder with parallel interface		Incremental encoder		Encoder supply	
Terminal	Desc.	Definition	Desc.	Definition	Desc.	Definition	Desc.	Definition
1								
2								
3							24V	+24 V enc. supply
4							4.6V	+4.6 V enc. supply
5	T	Clock output						
6								
7								
8	D	Data input			A	Channel A		
9					B	Channel B		
10					R	Reference pulse		
11			D1	Data input bit 0				
12			D2	Data input bit 1				
13			D3	Data input bit 2				
14			D4	Data input bit 3				
15								
16			D5	Data input bit 4				
17			D6	Data input bit 5				
18			D7	Data input bit 6				
19			D8	Data input bit 7				
20								
21								
22								
23							GND	GND enc. supply
24							GND	GND enc. supply
25	$\overline{T}$	T inverted						
26								
27								
28	$\overline{D}$	D inverted			$\overline{A}$	A inverted		
29					$\overline{B}$	B inverted		
30					$\overline{R}$	R inverted		
31			D9	Data input bit 8				
32			D10	Data input bit 9				
33			D11	Data input bit 10				
34			D12	Data input bit 11				
35								
36								
37								
38								
39								
40								

Signal Cable Shielding

Twisted pair cable must be used for the connections for absolute encoders with synchronous serial interfaces. The shielding is done through the specially built shield connection on the terminal block. The shield connections are linked directly to ground (⏚,i.e.: with the mounting rail).

Shielded connection cables are also recommended for absolute encoders with parallel interfaces.

16.2.9 Variable Declaration

The variable declaration for intelligent I/O processors is described in chapter “PG2000 Programming System” of the “B&R 2000 Software User's Manual”.

16.3 DS101

16.3.1 General Information

The DS101 module is a programmable I/O module with 3 differential outputs, 3 differential inputs, 16 digital inputs and 32 digital outputs. The main area of application for this module is in the field of **Electronic Drum Sequencers.** The DS101 is basically the same as the DS100 but has 32 transistor outputs which the intelligent I/O processor handles without the support of the PCC CPU.

The drum sequencer gets its name from the mechanical drum sequencers which works by means of cam on a shaft. Every disc represents a certain output which during the rotation of the shaft is active in certain positions.
The electronic functionality of drum sequencer has the following advantages over the mechanical camshaft:

- Higher switching precision
- Switching cycle does not cause wear
- Easier disc adjustment
- Pre-stop times

The DS101 I/O processor in use as a drum sequencer can calculate the output states of up to 128 outputs according to the actual angular position. In addition, a time can be calculated to compensate for switching times. The output states are stored in the DPR (Dual Port RAM) and can be read cyclically by the PCC CPU and recopied to any digital output modules.

To read the actual angular position, the following encoders can be hooked up to the differential inputs or outputs of the DS101 module:

- Absolute encoder with synchronous serial interface (SSI)
- Absolute encoder with parallel interface
- Incremental encoder

The method of coding (gray or dual) as well as the encoder resolution can be defined by the user with software (function block).
The encoder supply comes from the module as well. It is electrically isolated from the PCC, short circuit protected and current limited and is available on the terminal block.

The electronic drum sequencer can be configured by the user using function blocks. The respective software can be obtained from B&R (including documentation).

16.3.2 Technical Data

Module ID	DS101	
Model Number	2DS101.60-1	
Description	2010 Electronic Drum sequencer, absolute encoder, SSI/parallel, 16 Bit, 3 differential inputs, RS422 level, 100 kHz, 3 differential outputs, RS422 level, 100 kHz, 16 digital inputs 24 VDC, 5 µsec, Sink, 32 digital outputs 24 VDC, 0.5 A, Order terminal blocks separately!	
C-UL-US Listed	in preparation	
B&R ID Code	$1B	
Module Type	B&R 2010 I/O module	
Base Plate Module	BP200, BP201, BP210	
Communication	RISC processor	
Instruction Cycle Time	0.8 µsec	
Dual Ported RAM (DPR)	384 Byte SRAM (not buffered)	
System RAM	256 KByte SRAM (not buffered)	
Encoder Supply (internal)	Electrical isolation, short circuit protection and current limitation	
Encoder Supply Voltage	24 V ±10%	4.6 V ±10%
Load	Max. 120 mA	Max. 120 mA
Encoders Used		
Absolute Encoder (Single Turn) Coding Resolution	Synchronous serial Interface (SSI) Gray or dual Max. 16 Bit (range: 4096 steps)	Parallel interface Gray or dual Max. 12 Bit

Module ID	DS101
Differential Outputs	
Number of Differential Outputs	3
Electrical Isolation Output - PCC Output - Output	 Yes (optocoupler) No
Differential Outputs	
Output Level	RS422
Output Frequency	Max. 100 kHz
Differential Inputs	
Number of Differential Inputs	3
Electrical Isolation Input - PCC Input - Input	 Yes (optocoupler) No
Input Level	RS422
Input Frequency	Max. 100 kHz
Digital Inputs	
Number of Inputs Total in Groups of	 16 4
Connection	Sink connection require (COM connections are to be connected to GND)
Electrical Isolation Input - PCC Group - Group Input - Input	 Yes (optocoupler) Yes (optocoupler) No
Input Voltage Nominal Maximum	 24 VDC 30 VDC
Input Resistance	4.4 kΩ
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V
Switching Delay log. 0 - log. 1 log. 1 - log. 0	(max. and typ.) 5 µsec (pulse width ≥ 20 µsec) 5 µsec (pulse width ≥ 20 µsec)
Count Frequency	Max. 25 kHz (ratio 1:1)
Digital Outputs	
Number of Digital Outputs Total 32 in Groups of	 8
Type	Transistor (source connection required)
Electrical Isolation Output - PCC Group - Group Output - Output	 Yes Yes No
Switching Voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current per Output per Group Module	 Max. 0.5 A Max. 4 A Max. 16 A

Module ID	DS101
Switching Delay log. 0 - log. 1 log. 1 - log. 0	 Typ. 5 µsec / max. 110 µsec Typ. 60 µsec / max. 100 µsec
Switching Frequency (resistive load)	Max. 500 Hz
Overload Protection	Yes
Starting after Overload Cutoff	Automatic after approx. 5 sec
Short Circuit Current	0.75 to 1.5 A
Protective Circuit Internal External	 Against overvoltage peaks up to 55 V (VDE 160) Against reverse polarity on the 24 V module supply Only if required (Surge)
Reverse Voltage when Switching Off Inductive Loads	45 to 55 V
Power Consumption 24 V Encoder Supply Voltage 4.6 V Encoder Supply Voltage	 13 W + 1.5 x encoder power 13 W + 2.5 x encoder power
Dimensions (H, W, D) [mm]	285, 80, 185

16.3.3 Differential Outputs

If the DS101 module is used as an electronic drum sequencer, the differential outputs are to be used to connect an absolute encoder via a synchronous serial interface.
By installing the proper software, other functions (e.g. frequency inputs or pulse width modulation outputs) can also be can also be realized. If digital inputs 9 to 16 are used, differential output 3 is no longer available for use.

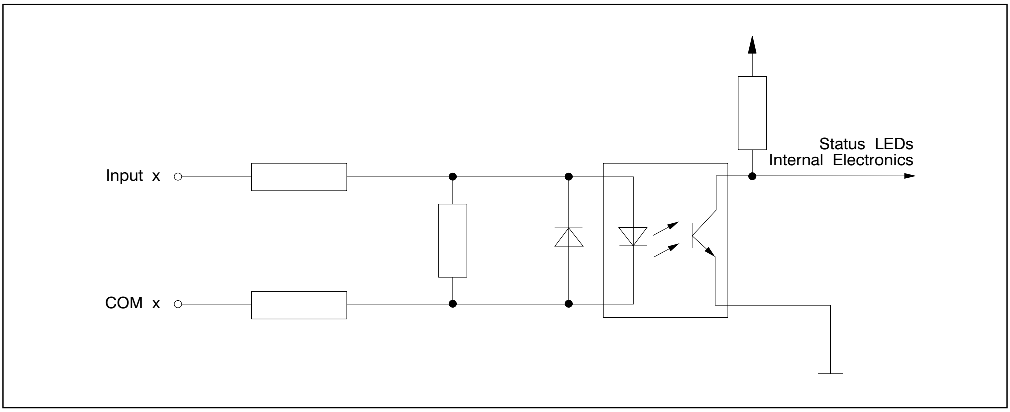
16.3.4 Differential Inputs

If the DS101 module is used as an electronic drum sequencer, the differential inputs are to be used to connect an absolute encoder via a synchronous serial interface.
By installing the proper software, the differential inputs can be used as impulse inputs or for gate time measurement for example.

16.3.5 Digital Inputs

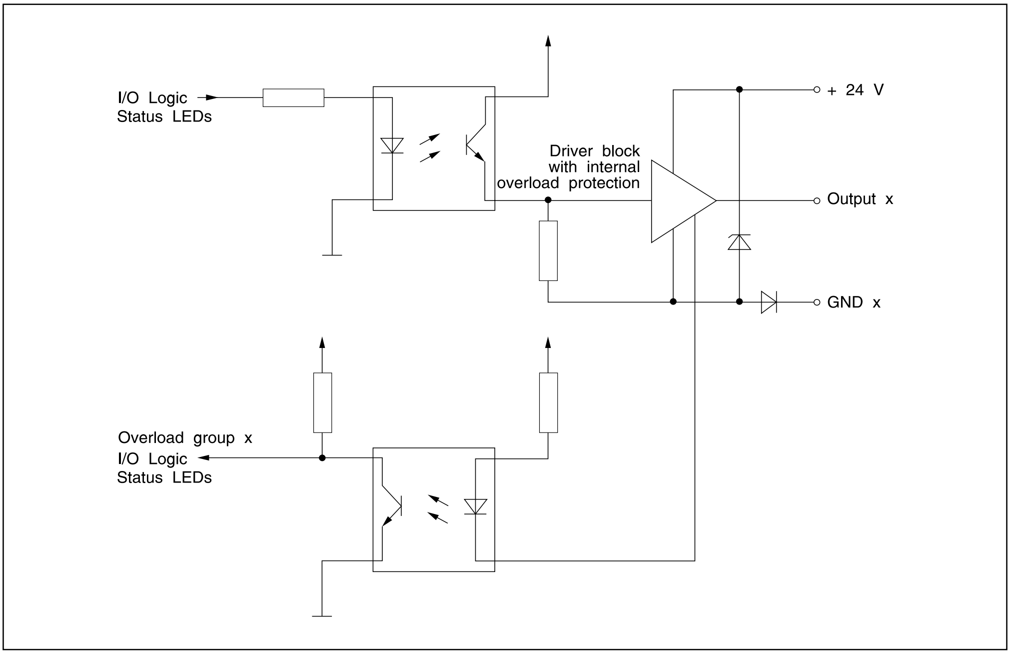
If the DS101 module is used as an electronic drum sequencer, the digital inputs are to be used to connect an absolute encoder via a parallel interface.
By installing the proper software, channels 1 to 8 can also be used as normal digital inputs, impulse inputs or for gate time measurement. Channels 9 to 16 are only used as normal digital inputs however.

Digital Input Circuit



16.3.6 Digital Outputs

Output Circuit for the Digital Outputs



Overload Protection

The overload protection circuit is activated in the following circumstances:

- ❍ The junction temperature of the transistor exceeds the allowed limitations (typical temperature limitation 150 °C, Min. 135 °C, Max. 175 °C). Cause: short circuit, overload or environmental temperature too high.
- ❍ The 24 V supply voltage (terminal block end) is lower than the normal 13 V (min. 10 V, max. 14.5 V)

The affected output is switched off until ...

... the junction temperature sinks to within the allowed limits again (Hysteresis typ. 20 °C). Switch-on time is within seconds.

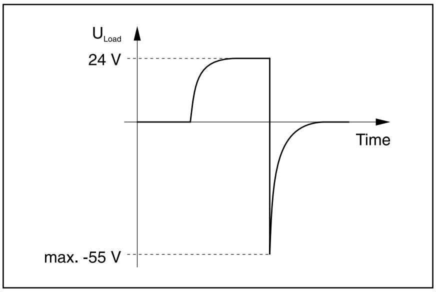
... the supply voltage is in the allowed range again (typ. > 14.5 V).

... the terminal block is properly connected.

Switching Inductive Loads

The transistor enables the fast and safe switching of inductive loads. It is not necessary to use an inverse diode on the inductive load. Note however that the maximum switching frequency is inductively limited by the fixed reverse voltage of 45 to 55 V.

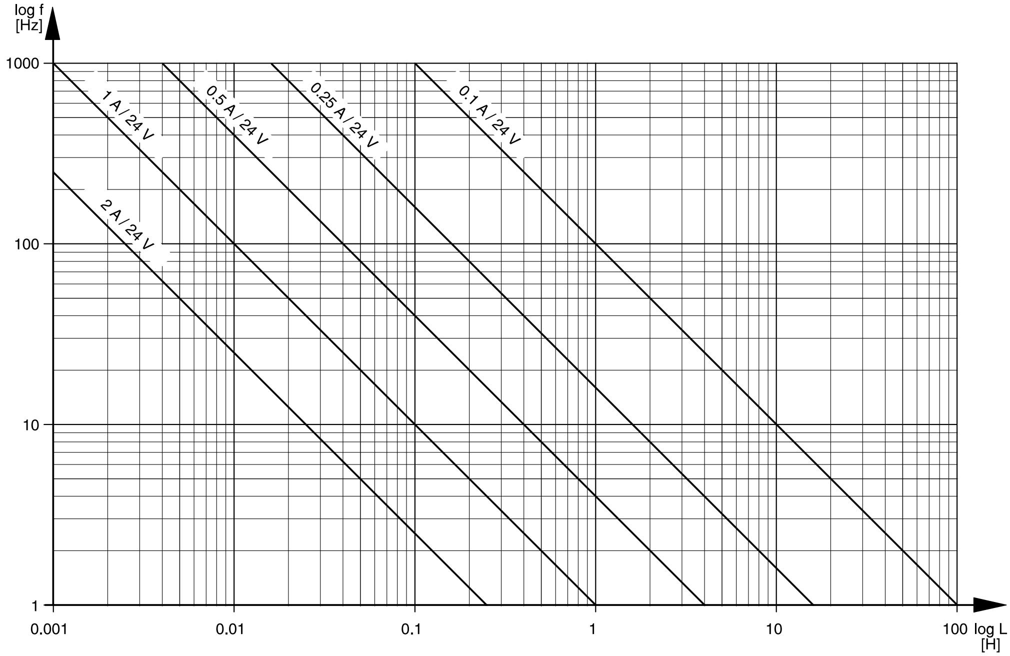
Reverse voltage: The reverse voltage is a negative voltage on the switching element (e.g. Valve). If the switching element does not allow operation with a negative voltage, an inverse diode must be installed externally in order to limit the voltage to approximately -0.6 V.



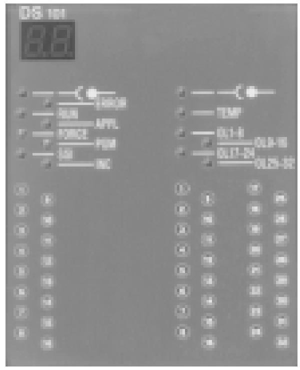
Reverse Voltage Diagram

The maximum switching frequency is reduced with increasing inductance. An inductance of 0.5 H can be switched without any problems with 0.5 Hz at 24 V / 0.5 A and 60 °C environmental temperature.

The maximum switching frequency for a given value for inductance can be calculated from the following graph:



16.3.7 Status LEDs



Status LEDs on the Left Half of the Module:

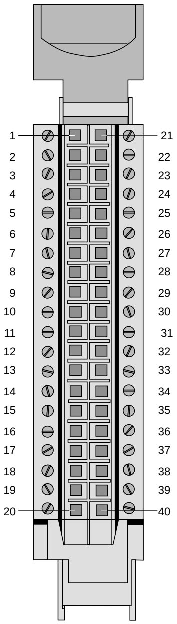
—< ●—	Indicates the terminal block status, i.e. if this LED is lit, the terminal block behind the left module door is not connected properly or there isn't one.
RUN	LED "RUN" light, if the intelligent I/O processor is in operation.
FORCE	EEPROM is used or original TPU code overload
SSI	This LED lights if an absolute encoder is connected with a synchronous serial interface (SSI) and delivers a signal.
ERROR	Error or undefined state.
APPL	The "APPL" LED lights if the application software is running.
PGM	The LED is lit if data is being exchanged between the PCC CPU and the intelligent I/O processor program.
INC	This LED has no function at this time (Reserved for incremental encoders).
1 ... 16	LEDs 1 to 16 indicates the logical state of the respective digital input.

Status LEDs on the Right Half of the Module:

—< ●—	Indicates the terminal block status, i.e. if this LED is lit, the terminal block behind the right module door is not connected properly or there isn't one.
TEMP	Indicates that all outputs will be switched off because of high temperature inside the housing.
OL x-y	Overload: These LEDs indicate that the overload protection switch or the short circuit protection switch has been activated for the respective output group. E.g. if the LED OL 1-8 is lit, outputs 1 to 8 are switched off (more information in section "Overload Protection").
1 ... 32	LEDs 1 to 32 indicate the logical status of the respective digital outputs. The LEDs light if the output is log. 1Y.

16.3.8 Terminal Assignments

Connections for the terminal block are behind the left module door (encoder connections):



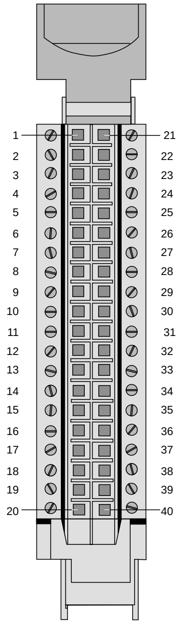
TB140

Terminal	Description	Group	Terminal	Description	Group
1	RXD[1)]		21	TXD[1)]	
2	Shield		22	GND[1)]	
3	24V ENCODER		23	GND ENCODER	
4	4.6V ENCODER		24	GND ENCODER	
5	Differential Output 1 +		25	Differential Output 1 -	
6	Differential Output 2 +		26	Differential Output 2 -	
7	Differential Output 3 +		27	Differential Output 3 -	
8	Differential Input 1 + / A[2)]		28	Differential Input 1 - / $\overline{A}$[2)]	
9	Differential Input 2 + / B[2)]		29	Differential Input 2 - / $\overline{B}$[2)]	
10	Differential Input 3 + / R[2)]		30	Differential Input 3 - / $\overline{R}$[2)]	
11	Digital Input 1		31	Digital Input 9	
12	Digital Input 2		32	Digital Input 10	
13	Digital Input 3	1	33	Digital Input 11	3
14	Digital Input 4		34	Digital Input 12	
15	COM (1-4)		35	COM (9-12)	
16	Digital Input 5		36	Digital Input 13	
17	Digital Input 6		37	Digital Input 14	
18	Digital Input 7	2	38	Digital Input 15	4
19	Digital Input 8		39	Digital Input 16	
20	COM (5-8)		40	COM (13-16)	

1) RS232 connection for VT100 terminal (in order to be able to work with IP Monitor). If terminals are not connected, connections 1 and 21 are to be jumped by the user.

2) Incremental encoder

Connections for the terminal block are behind the left module door:



TB140

Terminal	Description	Group	Terminal	Description	Group
1	Digital Output 1	1	21	Digital Output 17	3
2	Digital Output 2		22	Digital Output 18	
3	Digital Output 3		23	Digital Output 19	
4	Digital Output 4		24	Digital Output 20	
5	+24 V (1-8)		25	+24 V (17-24)	
6	Digital Output 5		26	Digital Output 21	
7	Digital Output 6		27	Digital Output 22	
8	Digital Output 7		28	Digital Output 23	
9	Digital Output 8		29	Digital Output 24	
10	GND (1-8)		30	GND (17-24)	
11	Digital Output 9	2	31	Digital Output 25	4
12	Digital Output 10		32	Digital Output 26	
13	Digital Output 11		33	Digital Output 27	
14	Digital Output 12		34	Digital Output 28	
15	+24 V (9-16)		35	+24 V (25-32)	
16	Digital Output 13		36	Digital Output 29	
17	Digital Output 14		37	Digital Output 30	
18	Digital Output 15		38	Digital Output 31	
19	Digital Output 16		39	Digital Output 32	
20	GND (9-16)		40	GND (25-32)	

16.3.9 Encoder Connection

The following encoders can be connected to the DS101 module:

- ❍ Absolute encoder with synchronous serial interface (SSI)
- ❍ Absolute encoder with parallel interface
- ❍ Incremental encoder

Terminal	Absolute encoder with syn. serial interface		Absolute encoder with parallel interface		Incremental encoder		Encoder supply	
	Desc.	Definition	Desc.	Definition	Desc.	Definition	Desc.	Definition
1								
2								
3							24V	+24 V enc. supply
4							4.6V	+4.6 V enc. supply
5	T	Clock output						
6								
7								
8	D	Data input			A	Channel A		
9					B	Channel B		
10					R	Reference pulse		
11			D1	Data input bit 0				
12			D2	Data input bit 1				
13			D3	Data input bit 2				
14			D4	Data input bit 3				
15								
16			D5	Data input bit 4				
17			D6	Data input bit 5				
18			D7	Data input bit 6				
19			D8	Data input bit 7				
20								
21								
22								
23							GND	GND enc. supply
24							GND	GND enc. supply
25	$\overline{T}$	T inverted						
26								
27								
28	$\overline{D}$	D inverted			$\overline{A}$	A inverted		
29					$\overline{B}$	B inverted		
30					$\overline{R}$	R inverted		
31			D9	Data input bit 8				
32			D10	Data input bit 9				
33			D11	Data input bit 10				
34			D12	Data input bit 11				
35								
36								
37								
38								
39								
40								

Signal Cable Shielding

Twisted pair cable must be used for the connections for absolute encoders with synchronous serial interfaces. The shielding is done through the specially built shield connection on the terminal block. The shield connections are linked directly to ground (⏚,i.e.: with the mounting rail).

Shielded connection cables are also recommended for absolute encoders with parallel interfaces.

16.3.10 Variable Declaration

The variable declaration for intelligent I/O processors is described in chapter "PG2000 Programming System" of the "B&R 2000 Software User's Manual".

16.4 ULTRASONIC TRANSDUCER MODULE - NC303

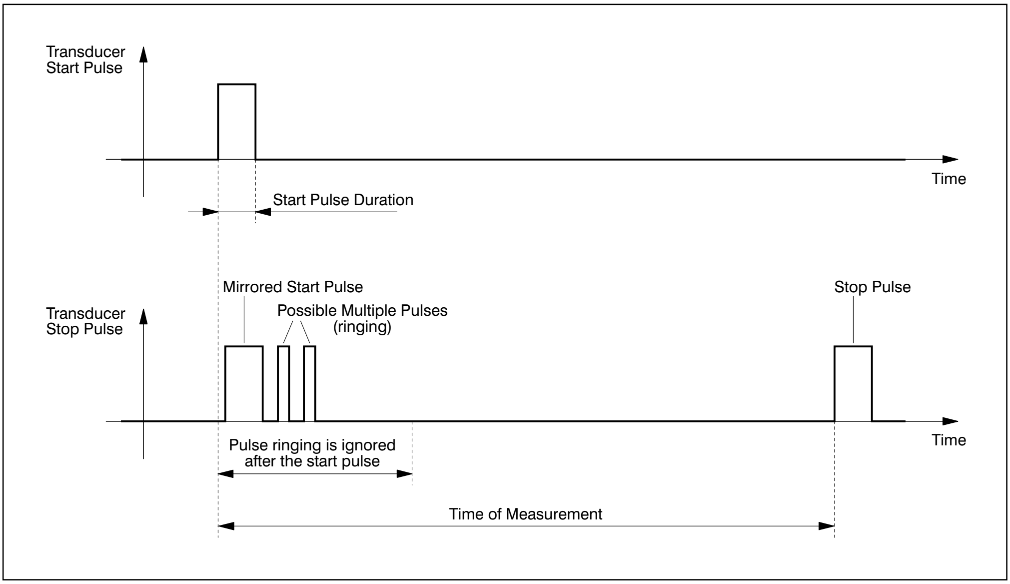
16.4.1 General Information

The NC303 ultrasonic transducer module consists of an intelligent I/O processor for an ultrasonic transducer with additional digital and analog inputs/outputs.
The ultrasonic transducer module is a programmable I/O module with four channels for distance measurement, one channel for RPM measurement (rotation speed measured with pulse counting and gate time measurement) as well as four analog inputs, five analog outputs, four digital inputs and five digital outputs..
When the software is installed, the processor for the ultrasonic transducer module independently executes distance measurement with plausibility checks and RPM measurement. The data of the ultrasonic transducer module is put into the DPR (Dual Ported RAM) and can be read cyclically from the PCC CPU.
Distance and RPM measurement can be programmed by the user with function blocks. The respective software (with documentation) can be obtained through your local B&R representative.

Distance Measurement

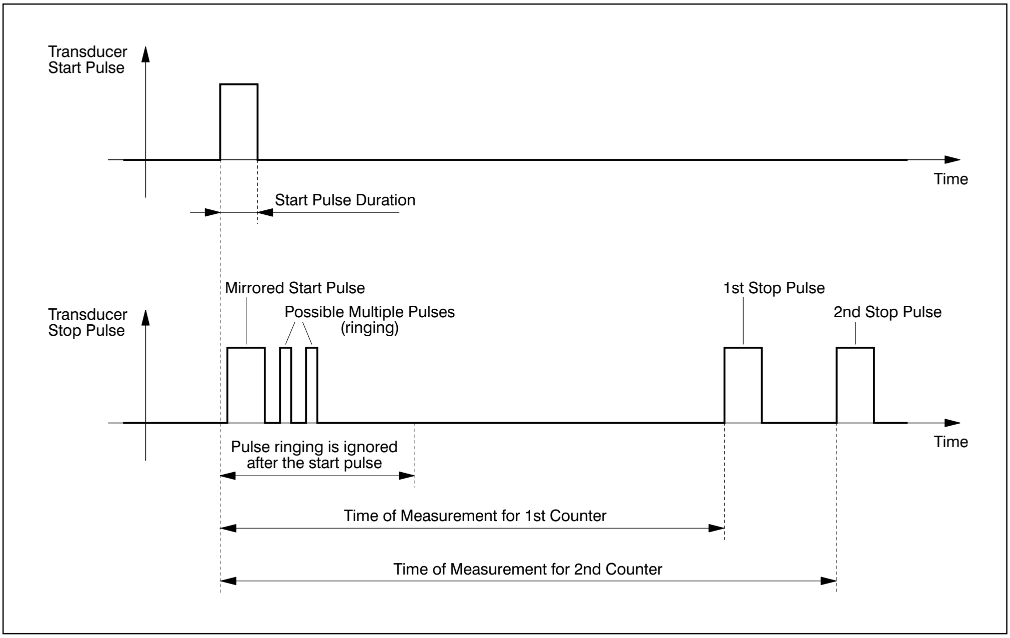
An ultrasonic transducer with a Start/Stop interface is used for distance measurement,.
The ultrasonic transducer generates a high current pulse (start pulse), causing a ring formed magnetic field, which runs down the length of a torsion bar (measurement rod). This magnetic field collides with the field of a moving ring magnet and generates a magnetic contraction in a magnetostrictive rod. This contraction is sent out as an ultrasonic pulse. The ultrasonic pulse given to the transducer is received by an ultrasonic receiver and converted to an electrical pulse (stop pulse). The time between the positive edge of the start pulse and the positive edge of the stop pulse is directly proportional to the path distance. This time is measured in the module and evaluated.

Single Magnet Measurement



All pulses which are received within approximately 18 µsec after the start of the measurement are not evaluated so that multiple pulses (ringing) that occurs with some transducers do not affect measurements (pulse ringing after start pulse is ignored).

Double Magnet Measurement (only possible through channel 1)



RPM Measurement

For determining the RPM, encoder pulses are counted and the gate duration (time between the positive and the negative edges of a pulse) is measured.

16.4.2 Technical Data

Module ID	NC303	
Model Number	2NC303.60-1	
Description	2010 Ultrasonic Transducer Module, 1 pulse encoder input, 700 Hz, 24 VDC, 4 inputs for ultrasonic transducer, 56 MHz, 4 digital inputs 24 VDC, 10 msec, Sink, 4 transistor outputs 24 VDC, 1 A, 4 analog inputs 0 to 10 V, 12 Bit, 5 analog outputs +/- 10 V, 12 Bit, Order terminal blocks separately!	
C-UL-US Listed	Yes	
B&D ID Code	$17	
Module Type	B&R 2010 I/O module	
Base Plate Module	BP200, BP201, BP210	
Communication	RISC processor	
Instruction Cycle Time	0.8 µsec	
Dual Ported RAM (DPR)	384 Byte SRAM (not buffered)	
System RAM	256 KByte SRAM (not buffered)	
Encoder Supply	Ultrasonic Transducer (with differential signals) Internal	Pulse encoder External
Encoder Supply Voltage	24 V ±10 %	
Load	Max. 160 mA	
Pulse Encoder Input	RPM measurement (pulse counter and gate measurement)	
Electrical Isolation	Yes (optocoupler)	
Input Voltage Nominal Maximum	 24 VDC 30 VDC	
Input Resistance	4.5 kΩ	

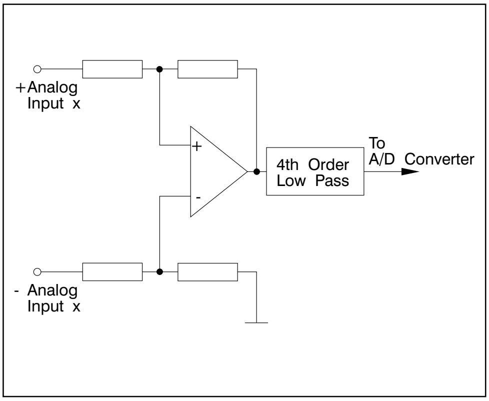
Module ID	NC303
Pulse Encoder Input	
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 15 V >15 V
Pulse Frequency	Max. 700 Hz
Resolution for Gate Measurement	7.69 µsec
Channels for Path Measurement	
Encoder Type	Ultrasonic transducer with start/stop interface (differential signals)
Number of Channels	4
Electrical Isolation Channel - PCC Channel - Channel	 Yes (optocoupler) No
Input Resistance	500Ω
Dual Magnet Measurement	Only for channel 1
I/O Signals	Differential level
Internal Counter Frequency	56 MHz (positive edge)
Counter Size	21 Bit
Start Pulse Duration	Approx. 1 µsec
Pulse Ignored after Start Pulse	Approx. 18 µsec
Resolution for Path Measurement	0.05 mm (ultrasonic speed = 2800 m/sec)
Analog Inputs	
Number of Analog Inputs	4 voltage inputs (unipolar)
Electrical Isolation Input - PCC Input- Input	 Yes (optocoupler) No
Input Signal Nominal Min./Max.	 0 to +10 V -20 V to +20 V
Resolution	12 Bit
Conversion Time for all Inputs	≥1 msec
Differential Input Resistance	>900 kΩ
Input Filter	Low pass 4th order / cutoff frequency: 500 Hz
Measurement Precision Basic Precision at 20 °C Precision (0 to 60 °C) Common Mode Rejection	 ±0.25 % ±0.5 % 40 dB / 50 Hz
Analog Outputs	
Number of Analog Outputs	5 voltage outputs (bipolar)
Electrical Isolation Output - PCC Output - Output	 Yes (optocoupler) No
Output Signal	-10 V to +10 V
Resolution	12 Bit
Conversion Time for all Outputs	≥1 msec
Output Filter	Low pass 2nd order / cutoff frequency: 1 kHz
Max. Load per Output	10 mA (load ≥ 1kΩ)
Short Circuit Protection (current limit)	±15 mA

Module ID	NC303
Analog Outputs	
Measurement Precision Basic Precision at 20 °C Precision (0 to 60 °C)	 ±0.25 % ±0.5 %
Digital Inputs	
Number of Digital Inputs	4
Connection	Sink connection required (COM connections are to be connected to GND)
Electrical Isolation Input - PCC Input - Input	 Yes (optocoupler) No
Input Voltage Nominal Maximum	 24 VDC 30 VDC
Input Resistance	1.5 kW
Switching Threshold LOW Range Switching Range HIGH Range	 <5 V 5 to 11 V >11 V
Switching Delay log. 0 - log. 1 log. 1 - log. 0	 10 msec 10 msec
Input Current at Nominal Voltage	Approx. 5.7 mA
Maximum Peak Voltage	500 V for 50 µsec max. every 100 msec
Digital Outputs	
Number of Digital Outputs	4
Type	Transistor (Sink connection required)
Electrical Isolation Output - PCC Output - Output	 Yes (optocoupler) No
Supply Voltage (external) Nominal Maximum	 24 VDC 30 VDC
Continuous Current per Output	Max. 1A
Switching Delay log. 0 - log. 1 (resistive load) log. 1 - log. 0 (resistive load)	Depends on load and current ≤100 µsec ≤100 µsec
Switching Frequency (resistive load)	Max. 500 Hz
Overload and Short Circuit Protection[1]	Polymer PTC protection device (Polyswitch)[2]
Residual Voltage of Transistors	Max. 0.5 V (at 1A)
Power Consumption	21 W + 1.5 x encoder power
Dimensions (H, W, D) [mm]	285, 80, 185

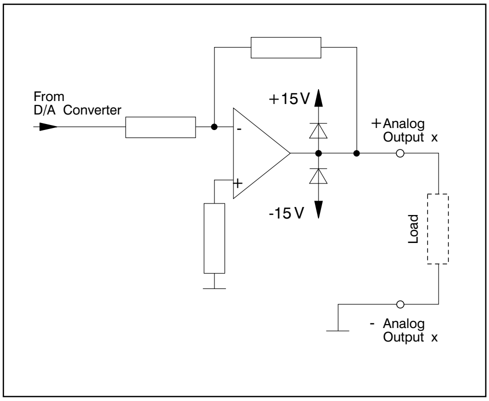
[1] Every digital output uses a Polymer PTC protection device for overload and short circuit protection. If an overload or a short circuit occurs, the PTC is set to high resistance and breaks the current loop. To reactivate the output, the external supply must be switched off and the error (overload or short circuit) must be corrected. After a reset time of > 10 seconds, the protection device is set back to normal.

[2] Polyswitch™ is a registered trademark of RAYCHEM.

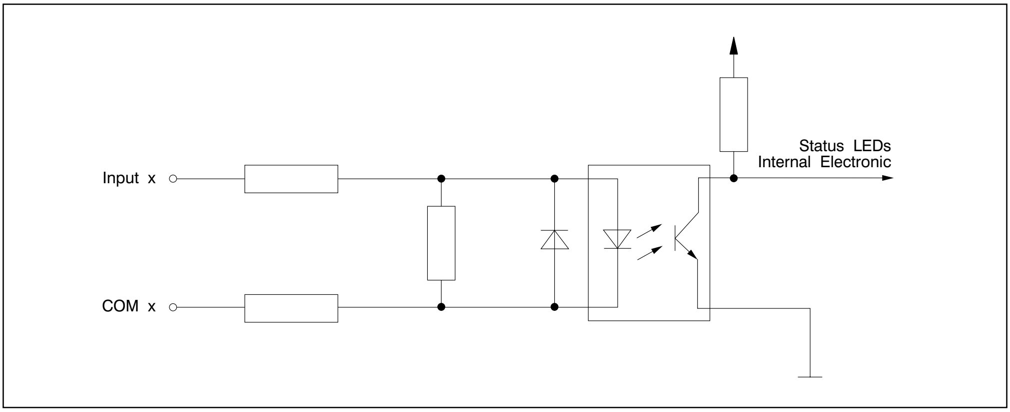
16.4.3 Analog Input Circuit



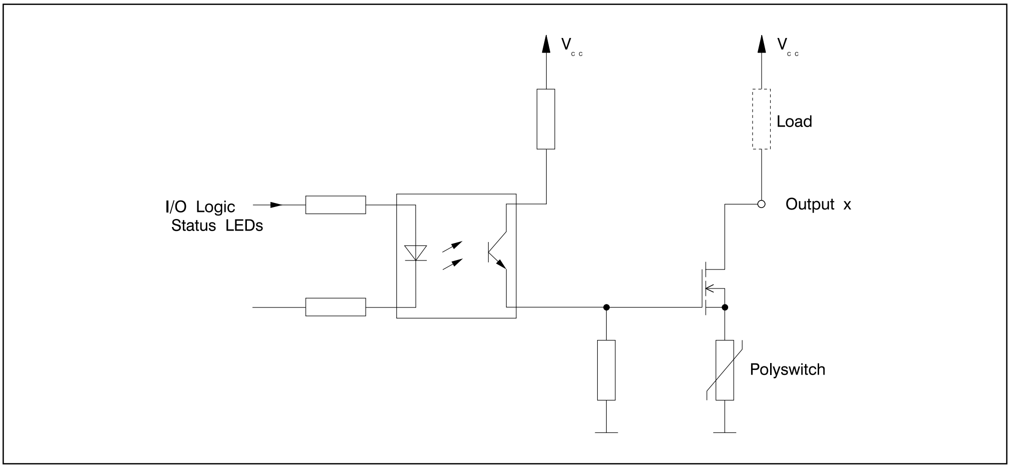
16.4.4 Analog Output Circuit



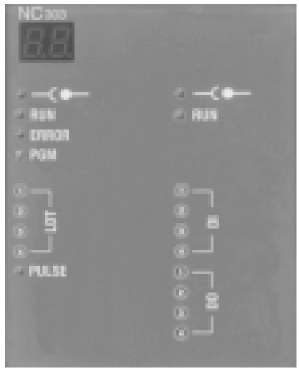
16.4.5 Digital Input Circuit



16.4.6 Digital Output Circuit



16.4.7 Status LEDs



Status LEDs on the left module half:

—< ●— Indicates the status of the terminal block, i.e. if this LED is lit either the terminal block is not connected or is not properly connected.

RUN The LED “RUN” lights, if the application software is running.

ERROR Error or undefined state.

PGM This LED lights if programs are exchanged between the PCC CPU and intelligent I/O processors.

LDT1 This LED lights, if an ultrasonic transducer is connected to channel 1 and signals are delivered.

LDT2 This LED lights, if an ultrasonic transducer is connected to channel 2 and signals are delivered.

LDT3 This LED lights, if an ultrasonic transducer is connected to channel 3 and signals are delivered.

LDT4 This LED lights, if an ultrasonic transducer is connected to channel 4 and signals are delivered.

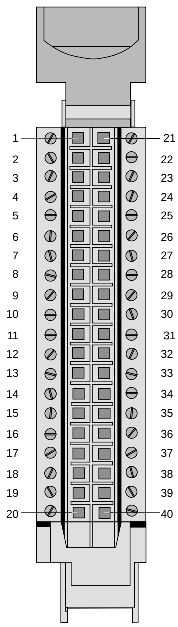
PULSE This LED indicates the logical state of the pulse input. The LED lights if the pulse input is log. 1.

Status LEDs on the right module half:

—< ●—	Indicates the status of the terminal block, i.e. if this LED is lit either the terminal block is not connected or is not properly connected.
RUN	This LED indicates that the Digital/Analog and Analog/Digital converters are operating.
DI1 ... DI4	These LEDs indicate the logical status of the assigned digital inputs. The LEDs light is the inputs are log. 1.
DO1 ... DO4	These LEDs indicate the logical status of the assigned digital outputs. The LEDs light is the outputs are log. 1.

16.4.8 Terminal Assignments for the NC303 Module

Terminal Block Connections behind the left module door:



TB140

Pins	Termination		Pins	Termination	
1	Reserved [1]		21	Reserved [1]	
2	Shield		22	Reserved	
3	Pulse input +		23	Pulse input -	
4	Shield		24	----	
5	+24 V		25	GND	
6	Start pulse	Channel1 +	26	Start pulse	Channel1 -
7	Stop pulse	Channel1 +	27	Stop pulse	Channel1 -
8	Shield		28	Reserved	
9	+24 V		29	GND	
10	Start pulse	Channel2 +	30	Start pulse	Channel2 -
11	Stop pulse	Channel2 +	31	Stop pulse	Channel2 -
12	Shield		32	Reserved	
13	+24 V		33	GND	
14	Start pulse	Channel3 +	34	Start pulse	Channel3 -
15	Stop pulse	Channel3 +	35	Stop pulse	Channel3 -
16	Shield		36	Reserved	
17	+24 V		37	GND	
18	Start pulse	Channel4 +	38	Start pulse	Channel4 -
19	Stop pulse	Channel4 +	39	Stop pulse	Channel4 -
20	Shield		40	Reserved	

[1] Pins 1 and 21 are to be linked with a bridge by the user.

"Reserved" refers to connections (excluding pins 1 and 21) which may not be wired! For modules with a rev. < 05.00 , pin 20 on the left terminal block is to be connected with pin 33 of the right terminal block.

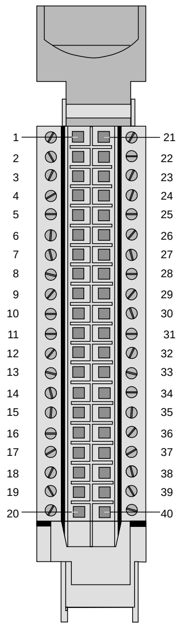
Encoder Cable Shielding

For the connection of the pulse encoder, shielded cable is to be used. The shielding is to be connected to a shield connection on the terminal block. The maximum permitted length of the cable for a pulse encoder is 100 meters.

For the cable to an ultrasonic transducer, shielded cable is also to be used. The shield must be connected to the shield connector on the terminal block. The maximum permitted length of cables for ultrasonic transducers with differential signals is 100 meters.

The six shield connections are to be connected directly to ground (⏚,i.e.: contact spring and mounting rail).

Terminal Block Connections behind the right module door:



TB140

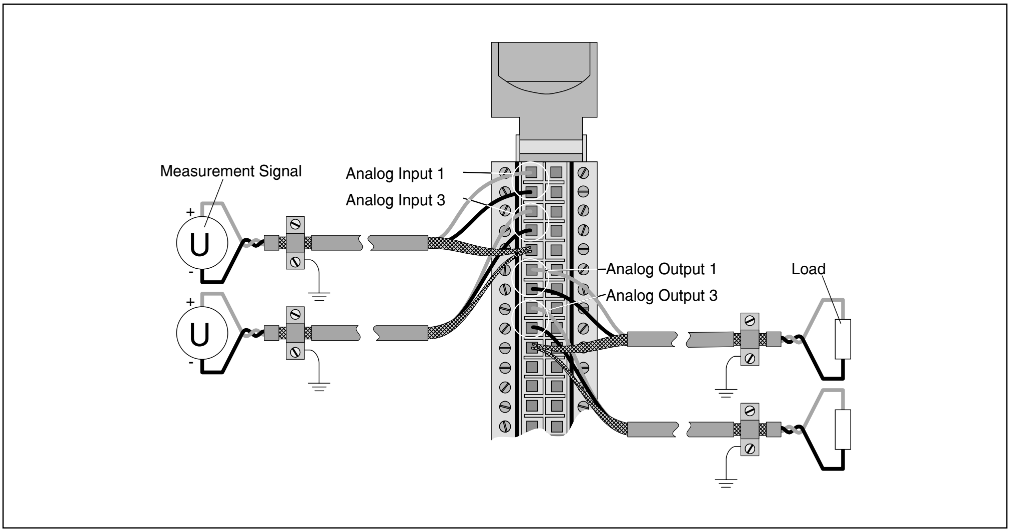
Pins	Termination		Pins	Termination	
1	+ Analog input	1	21	+ Analog input	2
2	- Analog input	1	22	- Analog input	2
3	+ Analog input	3	23	+ Analog input	4
4	- Analog input	3	24	- Analog input	4
5	Shield		25	Shield	
6	+ Analog output	1	26	+ Analog output	2
7	- Analog output	1	27	- Analog output	2
8	+ Analog output	3	28	+ Analog output	4
9	- Analog output	3	29	- Analog output	4
10	Shield		30	Shield	
11	+ Analog output	5	31	Reserved	
12	- Analog output	5	32	Reserved	
13	Shield		33	Shield	
14	Reserved		34	Reserved	
15	Digital input	1	35	Digital input	2
16	Digital input	3	36	Digital input	4
17	COM (Digital input 1-4)		37	COM (Digital input 1-4)	
18	+24 V (Digital output 1-4)		38	GND (Digital output 1-4)	
19	Digital output	1	39	Digital output	2
20	Digital output	3	40	Digital output	4

“Reserved” refers to connections which may not be wired!
For modules with a rev. < 05.00 , pin 20 on the left terminal block is to be connected with pin 33 of the right terminal block.

16.4.9 Analog Inputs and Outputs

Signal Cable Connection

Shielded cables are to be used for any analog input and output connections. The shielding is done for 2 analog inputs or 2 analog outputs at a time to the shield connection provided.



The six shield connections are to be connected directly to ground (⏚,i.e.: contact spring and mounting rail).

Numerical Value ↔ Input/Output Voltage Relationship

Input Voltage	Numerical Value		Output Voltage
	Hexadecimal	Decimal	
----	8000	-32768	-10 V
----	C000	-16384	-5 V
----	FFF0	-16	-4.88 mV
≤0 V	0000	0	0 V
2.44 mV	0008	8	0 V
4.88 mV	0010	16	4.88 mV
5 V	4000	16384	5 V
9.99756 V	7FF0	32752	10 V
10 V	7FF8	32760	10 V

The step lengths of the analog inputs and outputs are varied, since the 12 bit resolution is spread over 10 V for the inputs and over 20 V for the outputs (± 10 V).

16.4.10 Variable Declaration

The variable declaration for intelligent I/O processors is described in chapter “PG2000 Programming System” of the “B&R 2000 Software User's Manual”.

17 MULTIPROCESSORS

17.1 GENERAL INFORMATION

Multiprocessors are used for decreasing the load on the CPU and increasing the computing power of the PCC system. Among other things, multiprocessors can take over the following tasks:

- Preprocessing data
- Data preparation
- Monitor functions for start-up and service
- Communication through the serial interfaces

The Multiprocessor communicates with the CPU through a common memory area (Dual Ported RAM). The multiprocessor also has a system bus interface through which it can actively access the system bus and therefore other system modules and the CPU as well as exchange data.

CPUs and multiprocessors are software compatible. That means all programs on the CPU (e.g. application tasks) can also be run on the multiprocessor. The multiprocessor can be programmed via the RS232 interface.

17.2 TECHNICAL DATA

Module ID	MP100
Model Number	2MP100.5
Description	2010 Multiprocessor, 64 + 256 KB SRAM, 1 RS232 interface, 1 electrically isolated RS485/RS422, RS485/RS422: network capable, Order application memory separately!
C-UL-US Listed	Yes
B&R ID Code	$2D
Module Type	B&R 2010 system module
Base plate Module	BP101, BP110
Communication	RISC processor
Instruction Cycle Time	0.8 µsec
Dual Ported RAM (DPR)	64 KByte SRAM
System RAM	256 KByte SRAM
Application Memory(not incl.)	ME910, ME913 or ME915
Buffering RAM Lithium Battery (in APM) Gold Foil Capacitor (in APM)	 At least 1 year [1)] At least 5 min
Battery Monitoring	Yes
System Bus	Yes
Reset Button	Yes
Status Display	8 Status LEDs
Standard Communication Interfaces	
Application Interface (IF1) Electrical Isolation Connector Max. Distance Max. Baudrate	RS232 No 9 pin D-type plug 15 m / 19200 Baud 64 kBaud

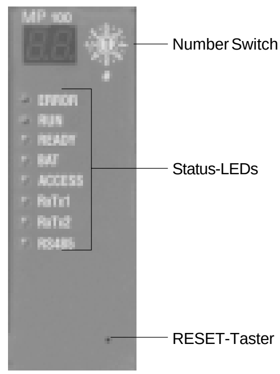
Module ID	MP100
Standard Communication Interfaces	
Application Interface (IF3) Electrical Isolation Connector Max. Distance Max. Baudrate	RS485 / RS422[2)] Yes 9 pin D-type socket 1200 m 347 kBaud
Power Consumption (incl. APM)	Max. 12 W
Storage Temperature	APM inserted incl. lithium battery: -20 °C to +60 °C
Dimensions (H, W, D) [mm]	285, 80, 185

1) Buffering is handled by the lithium battery in the APM. Buffering only lasts 6 months since the RAM is buffered in the APM and in the MP100.

2) The interface can be set using software.

17.3 STATUS DISPLAY

17.3.1 Status LEDs



ERROR This LED lights if the processor is in halt state or if the operating system is not running properly.

RUN The “RUN” LED lights if at least one application is running.

READY The multiprocessor is running properly.

BAT If this LED is lit, the voltage of the lithium battery in the application memory module is not enough to buffer the RAM if there is no power to the PCC. The APM, Dual Ported RAM and system RAM are buffered with the RAM buffering.

ACCESS This LED is lit if the multiprocessor accesses the CPU or other system modules over the system bus.

RxTx1 This LED lights if data is sent or received through IF1 (programming device interface).

RxTx2 This LED lights if data is sent or received through IF3 (application interface).

RS485 The configuration for IF3 (application interface) is indicated with this LED:

LED **lit**: IF3 is configured as RS485.

LED **dark**: IF3 is configured as RS422.

17.3.2 Number Switch

The number switch is used to set the module address at which the multiprocessor is found on the system bus. The address which is set with this switch is displayed immediately to its left on the 7 segment display. Make sure no other system module has the same module address.

System modules must be installed next to the CPU and no empty slots are allowed between system modules.

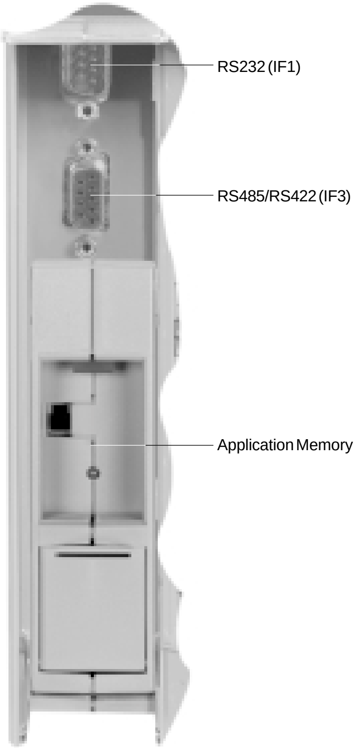
17.3.3 Reset Button

The reset button can be pressed with a small point object (e.g. a pen). Pressing this button causes a hardware reset on the multiprocessor (only the multiprocessor is reset). However, the multiprocessor can also be reset through the CPU with a Global Hardware Reset.

17.4 CONNECTION AREA

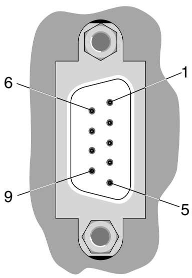
The area containing all connections is located behind the module door (interfaces and slot for application memory).

Both interfaces are freely available to the user. Communication with PG2000 is carried out via the application interface IF1 (RS232).



17.5 APPLICATION INTERFACE (IF1)

This interface is also suitable for the connection of fibre optics cable. The fibre optics cable is supplied through the short circuit protected 4.8 V supply voltage (4.8 V ±6%, max. 200 mA) of Pin 4 on the D-type (M) connector.

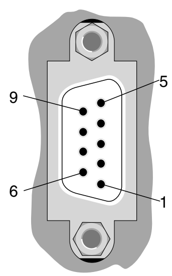
<table>
<tr><th>Interface</th><th>Description</th><th colspan="3">Pin-outs</th></tr>
<tr><td rowspan="10">Application Interface RS232


9 Pin D-type Connector (M)</td><td rowspan="10">The standard RS232 interface is used for connecting the programming device or a modem.

For online connections with the programming device, a standard RS232 cable is used. This cable can be obtained through B&R:
<table><tr><th>Description</th><th>Model Number</th></tr><tr><td>RS232 cable</td><td>0G0001.00-090</td></tr></table></td><td></td><td colspan="2">RS232</td></tr>
<tr><td>1</td><td>DCD</td><td>Data Carrier Detect</td></tr>
<tr><td>2</td><td>RXD</td><td>Receive Signal</td></tr>
<tr><td>3</td><td>TXD</td><td>Transmit Signal</td></tr>
<tr><td>4</td><td>DTR</td><td>Data Terminal Ready
(+4.8 V/150 mA)</td></tr>
<tr><td>5</td><td>GND</td><td>Ground</td></tr>
<tr><td>6</td><td>DSR</td><td>Data Set Ready</td></tr>
<tr><td>7</td><td>RTS</td><td>Request To Send</td></tr>
<tr><td>8</td><td>CTS</td><td>Clear To Send</td></tr>
<tr><td>9</td><td>RI</td><td>Ring Indicator</td></tr>
</table>

17.6 APPLICATION INTERFACE (IF3)

The RS485/RS422 interface is also suitable for the connection of fibre optics cable. The fibre optics cable is supplied through the short circuit protected 5 V supply voltage (5 V ±5%, max. 200 mA) of Pin 6 on the D-type (F) connector.

<table>
<tr><th>Interface</th><th>Description</th><th colspan="3">Pin-outs</th></tr>
<tr><td rowspan="10">Application Interface RS485/RS422


9 Pin D-type Connector (F)</td><td rowspan="10">The electronically isolated application interface is free for any purpose that the user might have for it. Configuring the interface is done with software through the application program.

The 5 V supply is electrically isolated and is used for connecting termination resistors (when networking more RS485 interfaces).

Max. Baudrate: 347 kBaud
Max. Cable Length: 1200 m [3900']</td><td></td><td>RS485</td><td>RS422</td></tr>
<tr><td>1</td><td>NC</td><td>NC</td></tr>
<tr><td>2</td><td>res.</td><td>TXD</td></tr>
<tr><td>3</td><td>DATA</td><td>RXD</td></tr>
<tr><td>4</td><td>NC</td><td>NC</td></tr>
<tr><td>5</td><td>GND</td><td>GND</td></tr>
<tr><td>6</td><td>+5 V / 200 mA</td><td>+5 V / 200 mA</td></tr>
<tr><td>7</td><td>res.</td><td>$\overline{TXD}$</td></tr>
<tr><td>8</td><td>$\overline{DATA}$</td><td>$\overline{RXD}$</td></tr>
<tr><td>9</td><td>NC</td><td>NC</td></tr>
</table>

18 DUMMY MODULE - BM100

18.1 GENERAL INFORMATION

All empty slots are to be filled with a dummy module.

18.2 TECHNICAL DATA

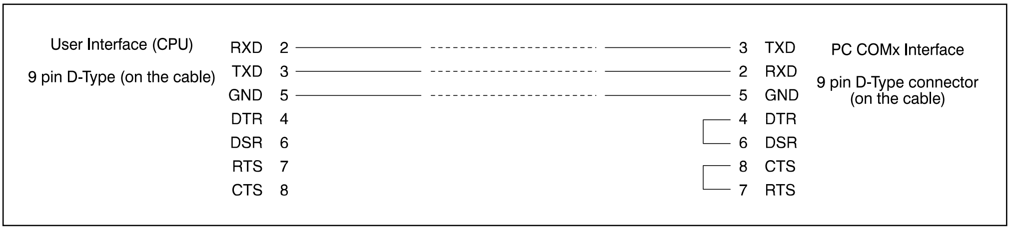
Module ID	BM100
Model Number	2BM100.9
Description	2010 dummy module
Dimensions (H, B, T) [mm]	285, 40, 185

CHAPTER 4

ACCESSORIES

1 RS232 CABLE

This cable is used to connect the CPU to the PG (PC), for example.



Description	Model Number
Cable, PC-System 2000 Controller, RS232	0G0001.00-090

2 EXPANSION CABLE

Two cables for connecting the expansion master and slave (local bus with expansion) are obtainable from B&R:

Description	Model Number
Cable, I/O Bus Expansion, 1 m	0G0010.00-090
Cable, I/O Bus Expansion, 2 m	0G0012.00-090

3 CONNECTOR FOR PROFIBUS AND REMOTE I/O

A special connector with integrated bus termination for PROFIBUS Networks and Remote I/O.

Description	Model Number
PROFIBUS connector with terminal resistance for cable type A	0G1000.00-090

4 CAN CONNECTOR

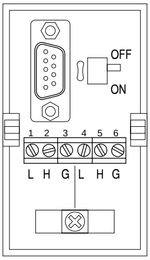
A bus connector is available for CAN Networks (T-Connector).

Description	Model Number
RIO Accessory, Bus Connector (CAN)	7AC911.9

5 CAN BUS ADAPTER FOR MOUNTING RAIL

A CAN adapter is used to connect the controller to a CAN network. Networking is achieved using a 6 pin terminal strip. Connection to the controller is carried out with a 9 pin D-type connector (F). A terminal resistor is integrated into the bus adapter. The terminal resistor can be switched on or off. The controller bus adapter cable is not available from B&R and should be procured independently.

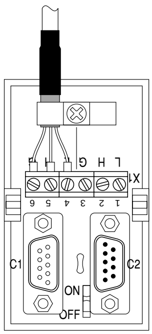
Description	Model Number
Accessories, Bus adapter (CAN)	0AC912.9



6 CAN BUS ADAPTER FOR MOUNTING RAIL (INCL. CABLE)

A CAN adapter is used to connect the controller to a CAN network. Networking is achieved using a 9 pin D-type plug (C1) and 9 pin D-type socket (C2). A 30 cm cable with D-type housing is connected to the 6 pin terminal block. This cable is used to make the connection to the controller. A terminal resistor is integrated into the bus adapter. The terminal resistor can be switched on or off.

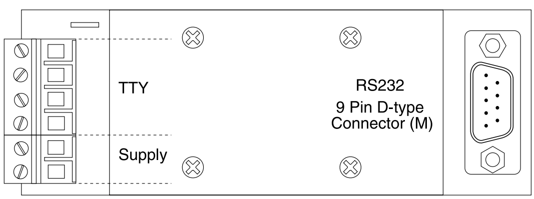
Description	Model Number
Bus adapter, CAN, 2 CAN interfaces, including 30 cm cable	0AC913.92



7 INTERFACE CONVERTER TTY - RS232

The AC410 interface converter converts a TTY signal into an RS232 signal or an RS232 signal into a TTY-signal. In order to incorporate a PANELWARE operator panel (e.g. P120 or P121), a 5V output voltage is formed from the 24 V voltage supply. This voltage is resistant up to 0.5A
The maximum baudrate amounts to 19200 Baud.

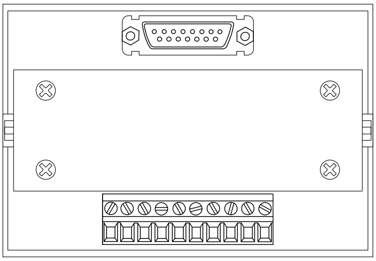
Description	Model Number
Accessories 24 VDC, RS232/TTY	0AC410.9



8 ENCODER ADAPTER

The encoder adapter is used together with the digital mixed module DM455. The adapter is used as a converter for 5 V encoders (absolute or incremental).

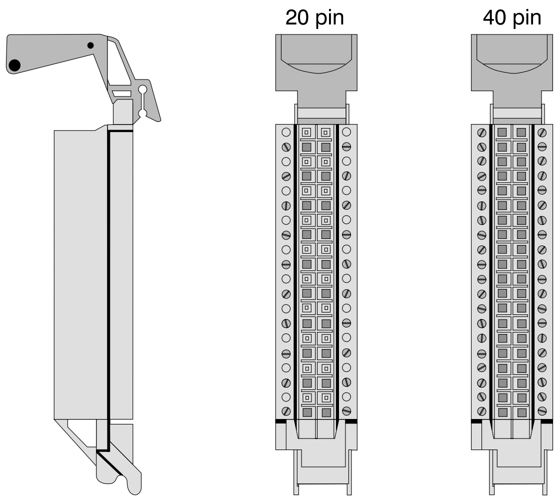
Description	Model Number
Accessories, Encoder 5V - 24V	0AC401.9



9 TERMINAL BLOCKS

Modules from the controller family B&R 2010 are connected by a double row terminal block. A detailed description can be found in chapter 4 "B&R 2010 Modules", section "Terminal Blocks".

Description	Model Number
Double Row Terminal Block TB120, 20 pin	2TB120.9
Double Row Terminal Block TB140, 40 pin	2TB140.9



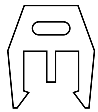
Chapter 4
Accessories

10 LITHIUM BATTERIES

For the following modules	CP100, CP104, CP200, CP210
Description	5 lithium batteries; 3 V / 950 mAh
Module Number	0AC201.9
Storage Requirements Storage Time Humidity	 max. 3 years at 30 °C 0 to 95 % (non-condensing)

For the following modules	ME910, ME913, ME915
Description	5 lithium Batteries; 3 V / 950 mAh
Module Number	0AC200.9
Storage Requirements Storage Time Humidity	 max. 3 years at 30 °C 0 to 95 % (non-condensing)

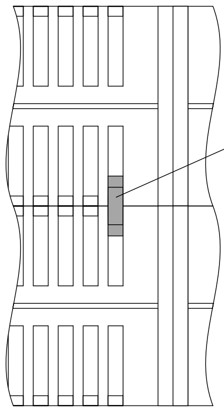
11 RETAINING CLAMPS



Accessory ID	Accessory, 1 x 500 clamps
Model Number	0AC001.9

In order to secure the modules, retaining clamps can be ordered for B&R Systems 2005 and 2010. By using these retaining clamps, the modules are attached to each other. Therefore the entire system becomes more stable.

The retaining clamps are inserted into the first ventilation slot (B&R 2010) or the second (B&R 2005), and they must be engaged with an audible "click". If the PCC system' environment is particularly susceptible to movement, retaining clamps can also be fitted from below.



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MODEL NUMBER INDEX

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RELEVANT CONVERSIONS

Metric and English Equivalents

Some of the values in this manual and in other documentation that you may have contain values which are only given in metric. Follow the formulas and charts on this page to help with any conversion problems that you may have.

Temperature

Below are two formulas to help in the conversion from Fahrenheit to Centigrade and vice versa.

Linear Measure & Weights

All B&R documentation includes the product dimensions, weights, distances for cabling and cutout sizes in metric. Use the conversions below to calculate these measurements into the equivalent English units.

Fahrenheit °F	Metric °C
-40	-40
-20	-28.89
-10	-23.33
-5	-20.56
0	-17.78
5	-15.00
10	-12.22
15	-9.44
20	-6.67
25	-3.89
30	-1.11
35	1.67
40	4.44
45	7.22
50	10.00
55	12.78
60	15.56
65	18.33
70	21.11
75	23.89
80	26.67
85	29.44
90	32.22
95	35.00
100	37.78
105	40.56
110	43.33
115	46.11
120	48.89
125	51.67
130	54.44
135	57.22
140	60.00
145	62.78
150	65.56

Metric °C	Fahrenheit °F
-40	-40.00
-35	-31.00
-30	-22.00
-25	-13.00
-20	-4.00
-15	5.00
-10	14.00
-5	23.00
0	32.00
5	41.00
10	50.00
15	59.00
20	68.00
25	77.00
30	86.00
35	95.00
40	104.00
45	113.00
50	122.00
55	131.00
60	140.00
65	149.00
70	158.00
75	167.00
80	176.00
85	185.00
90	194.00

$5/9 \times (°F - 32) = °C$

$(9/5 \times °C) + 32 = °F$

English Units	Metric Units
1 inch	25.4 millimeters 2.54 centimeters
1 foot	30.48 centimeters 3.048 decimeters 0.3048 meter
1 yard	0.9144 meter
0.03937 inch	1 millimeter
0.3937 inch	1 centimeter
3.937 inches	1 decimeter
39.37 inches 3.2808 feet 1.0936 yards	1 meter
3280.8 feet 1093.6 yards 0.62137 mile	1 kilometer

English Units	Metric Units
1 pound	0.45359 kilogram
1 ounce	28.350 grams
1 short ton	907.18 kilograms 0.90718 metric tons
1 long ton	1016.0 kilograms 1.0160 metric tons

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