Bosch turbo*scara* SR6 / SR8 planning manual

Ausgabe

1.0

BOSCH

Automation

Contents

1 turbo*scara* from Bosch

The turbo*scara* SR6 and SR8 are swivel arm robots (scara robots) with four-axes that have the following advantages

- Minimum cycle time with highest precision

- Large work space and various lift strokes

- Defined mechanical interfaces

- PC-control with a wide range of communication possibilities

- Conforms to international standards

- Brushless drive technology reduces repairs

- Integrated user installation, as an option: down to gripper for attaching a Tool Connector

- Integration of safety technology (safety class 3) is standard

- User power supply (24 V) in control rack

- Program language BAPS can be learned quickly and also allows the creation of clear and understandable programs; new with BAPSplus: graphical program interface

- Can be expanded via compact and flexible input/output modules: B~IO modules or decentralised CAN-I/O modules

- Expandable via valve block system VTS02 with CAN connection for time-saving installation

The performance can also be seen in the accompanying service offer

- Comprehensive hotline service for all of your questions concerning the robots

- Competent representatives in your area: our products are sold through one of our contract partners

- Fast on-site service from Bosch's customer service department or one of our contract partners

- Practical training of your employees in our training center.

2 System components

PHG 2000
Online programming
Operation
Diagnosis
Set machine parameters (MPP)

Robots
-turboscara SR6
-turboscara Sr8

Periphery
-SR CAN module in the robots

8 digital inputs
8 digital outputs
4 analog inputs

IQ200

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Field bus CAN1
-Set values
-Actual values
-Decentralised I/O

Field bus
-Decentralised I/O

Touchscreen

BF 200 T

Operation
Diagnosis

Offline programming
Online programming
SPS programming
Operation
Diagnosis
Set machine parameters (MP tool)

Periphery
-Sensors
-Actors
-I/O modules
e.g. B~IO modules with 16I/16O

The robot system SR6/SR8 consists of robust robotic mechanics with four freely programmable axes. With its high velocity and high loading capacity (up to 8 kg) the robot is predestined for assembly work and for fast Pick & Place motions.

At the core of the IQ200 robot controller is an industrial PC (rho4) with a Pentium MMX processor. The power supply (EVS) has a power supply pack for the internal voltage supply (24V) integrated with an emergency off circuit and safety technology: safety class 3 per EN 954. The digital drive booster (AV200) for the four individual axes exchanges data with the rho4 robot controller via a field bus (CAN 1). All three modules are developed as 19" plug-in assemblies.

Decentralised input and output modules or other periphery equipment, such as actuators and sensors, can be controlled via the field bus (CAN 1 or CAN 2).

Aside from the operating block, the robot can be operated by a hand-held programming unit (PHG2000), a touch screen (BF200T), or any PC. A keyboard, mouse, and monitor can also be directly hooked up to the robot controller (rho4).

The rho4 or an external PC can be used for programming the robot. Data or programs are exchanged via the serial interfaces or with the Internet protocol TCP/IP.

The hand-held programming device PHG2000 is used primarily to teach the robot and to diagnose errors. It can also change and edit robot programs.

The robot's movement programs are written in the pascal-like language BAPS (movement and sequence program language). BAPS robot programs can be created with a text editor or with the graphical programming tool BAPSplus. When needed, the integrated SoftSPS (PCL) can be programmed by the offline programming software WinSPS.

3   Robot turbo*scara* SR6/SR8

3.1 Variations

	Standard	Optional
Stand	length: 500 mm	250 to 700 mm in 50 mm intervals
		bracket for assembly on walls or ceilings
Lift (Sleeve)	200 mm ($\varnothing$ 20 mm)	200 mm ($\varnothing$ 25 mm) 400 mm ($\varnothing$ 25 mm)
Connection cable	2 m fixed wired	connecting cable with plug interface, 6, 10, or 20 m
User installation	user interface in installation area on arm 2	empty pipe leads from installation area on arm 2 to sleeve
		installation for the Tool Connector (electric and pneumatic)
Bellows	without	with bellows around sleeve
IQ200 Controller	19"-rack	in control cabinet with operating block and main switch
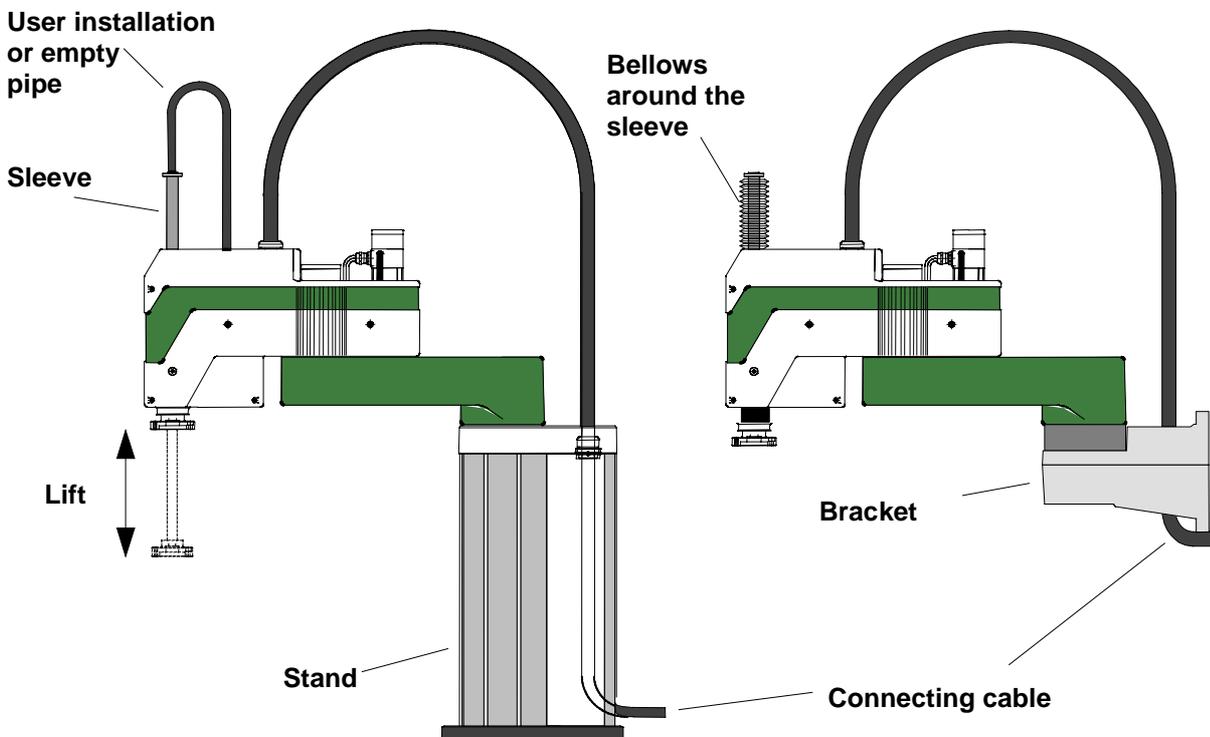
Variation: turbo*scara* SR6/SR8 dust proof

turbo*scara* SR6/SR8 dust proof is for use in especially severe conditions. This robot is completely sealed and uses the full scope of the turboscara family performance characteristics in dusty or wet work areas.

3.2 Aspects

3.2.1 turboscara SR6
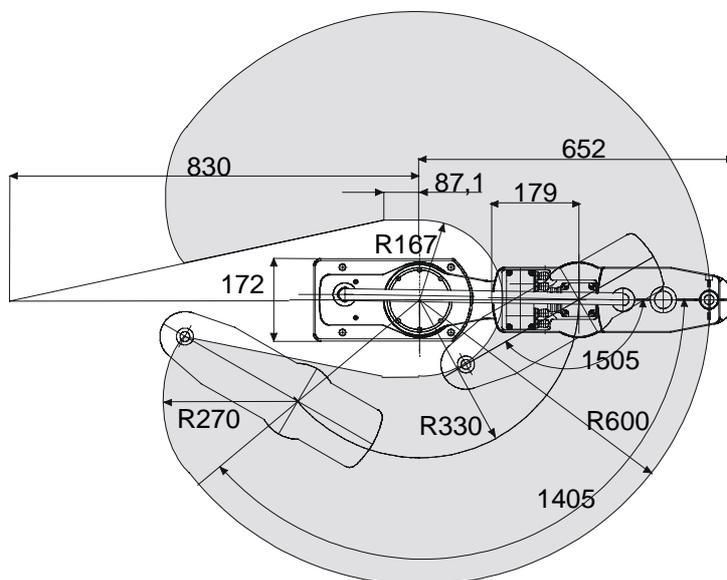
stand lenght S		250 bis 700		
lift axis 3 H		200	200	400
sleeve-Ø		20	25	25
Standard	sleeve height P	471	471	671
	flange height F	50	50	50
with bellows	sleeve height P	555	555	805
	flange height F	11	11	-14
with user installation	height of user installation I	700	700	980
with user installation and bellows	height of user installation I	730	730	1070

all data in [mm]
on call: axis 3 also with lift 600 mm
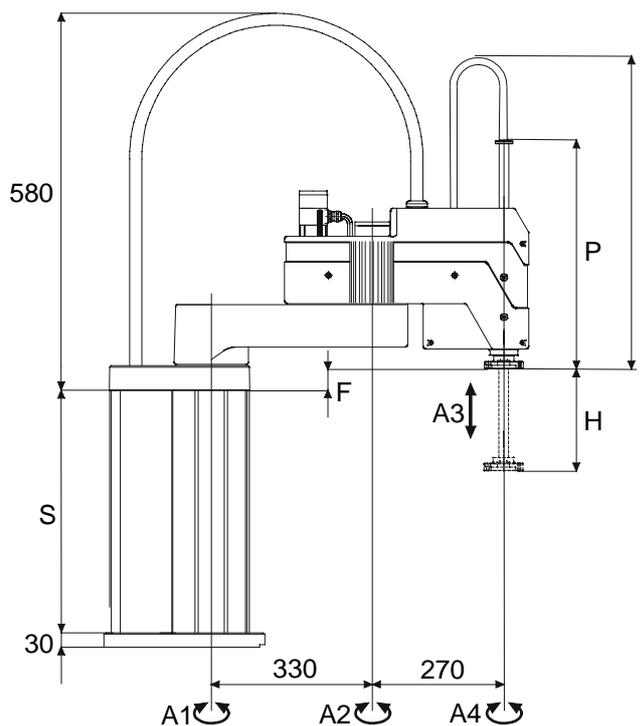
3.2.2 turbo*scara* SR8
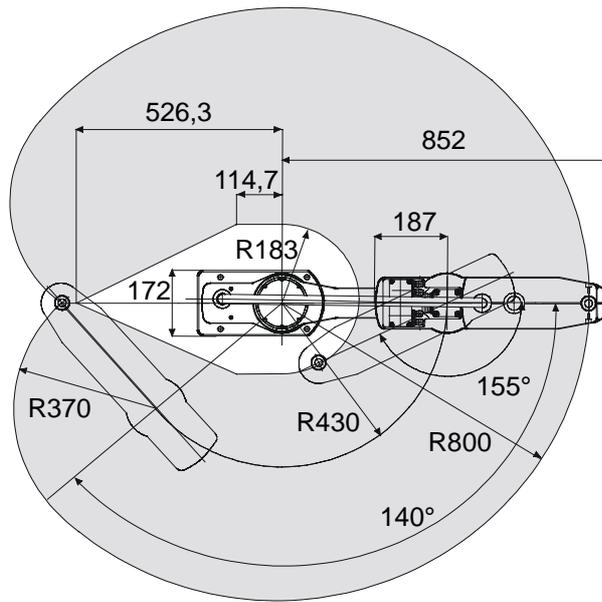
stand lenght S	250 bis 700		
lift axis 3 H	200	200	400
sleeve-Ø	20	25	25
Standard	sleeve height P	471	471	671
	flange height F	60	60	60
with bellows	sleeve height P	555	555	805
	flange height F	21	21	-4
with user installation	height of user installation I	700	700	980
with user installation and bellows	height of user installation I	730	730	1070

all data in [mm]
on call: axis 3 also with lift 600 mm
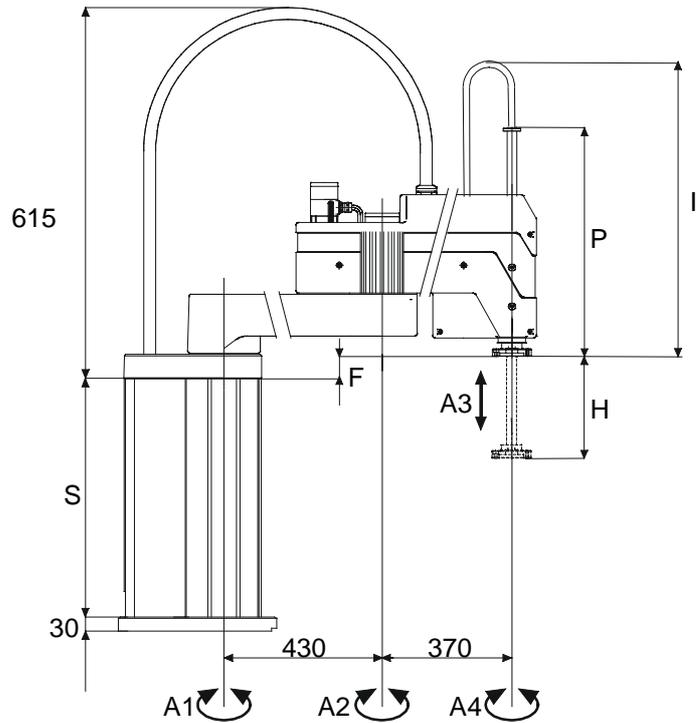
3.2.3 turboscara SR-DP

For the measurements of the seal variations please inquire at AT/VRO
(refer to 8.1). The main measurements are identical to the standard ver-
sions, merely the cover on arm 2 is slightly larger.

3.2.4 Base plate

The stand's base plate is fastened by 4 M12 bolts.
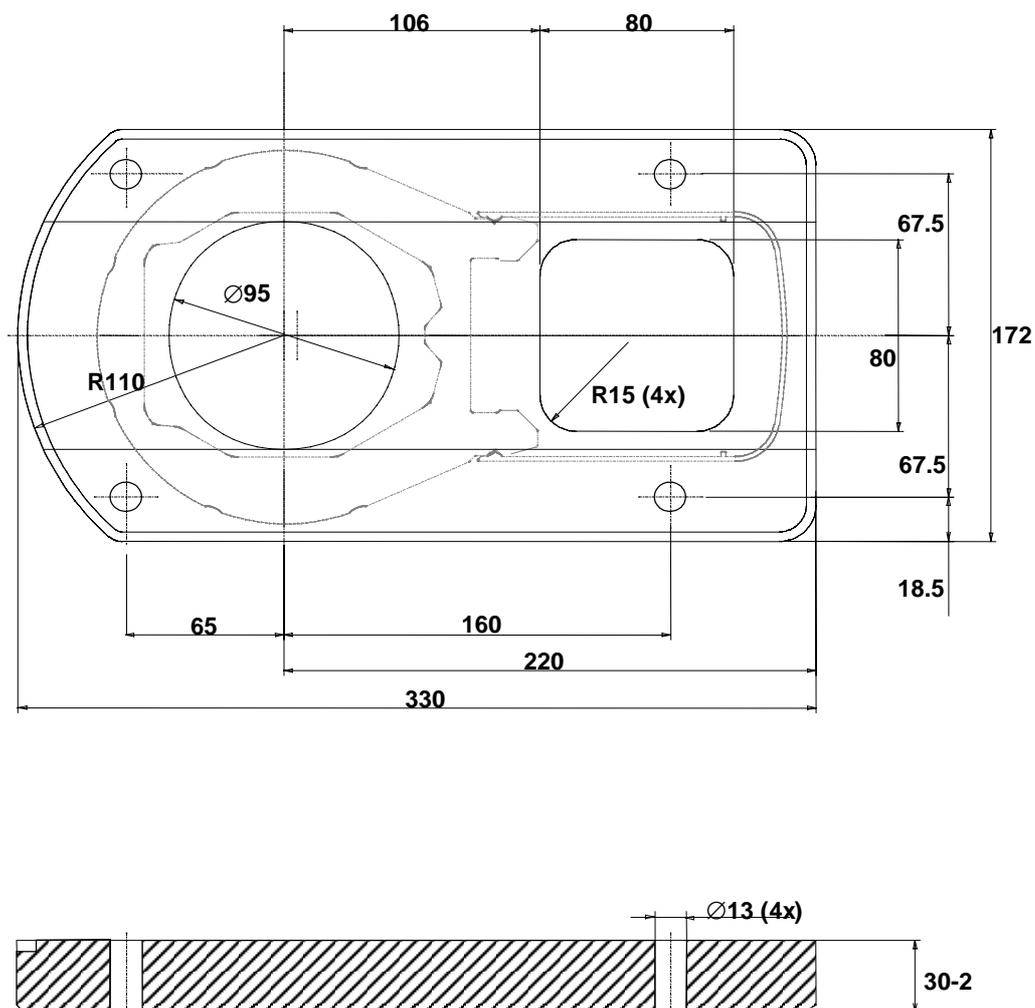
3.2.5 Bracket

The turbo*scara* SR6/SR8 can also be mounted on the wall or on the ceiling. In this case a bracket replaces the stand. This increases the possibilities to flexibly arrange your robot's work area.
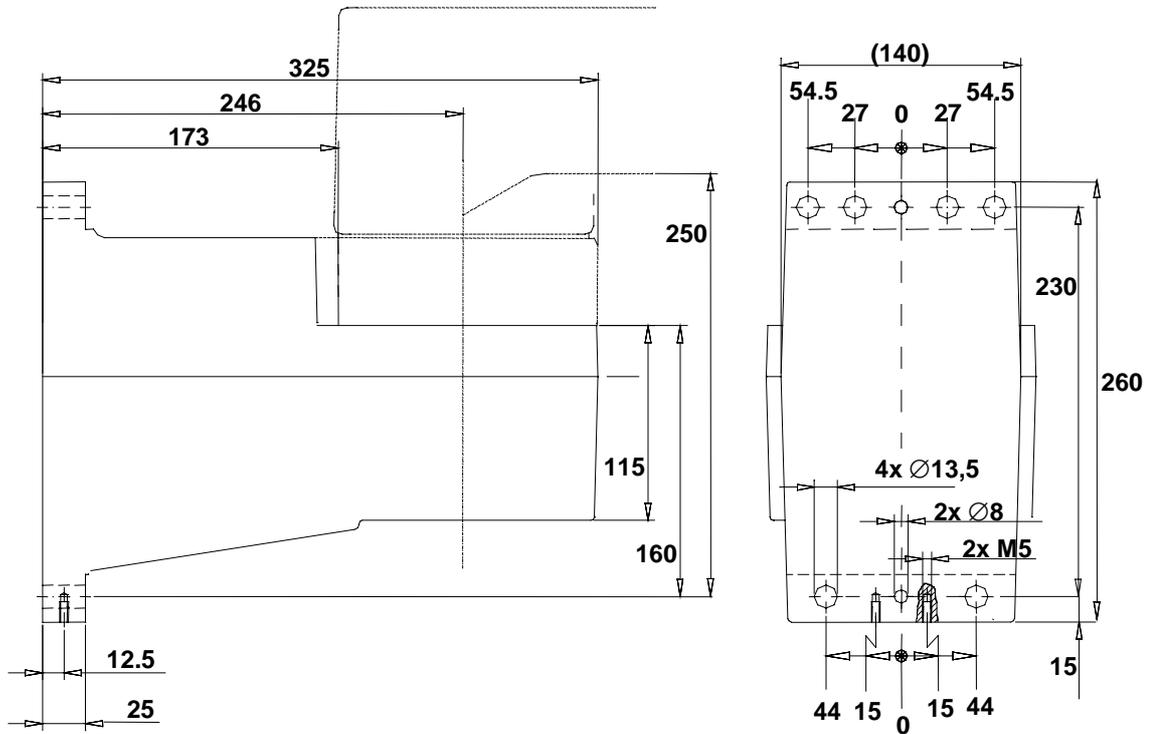
3.2.6 Gripper flange

The gripper flange is mounted on the sleeve and serves as a mount for a Tool Connector or other various gripper tools.
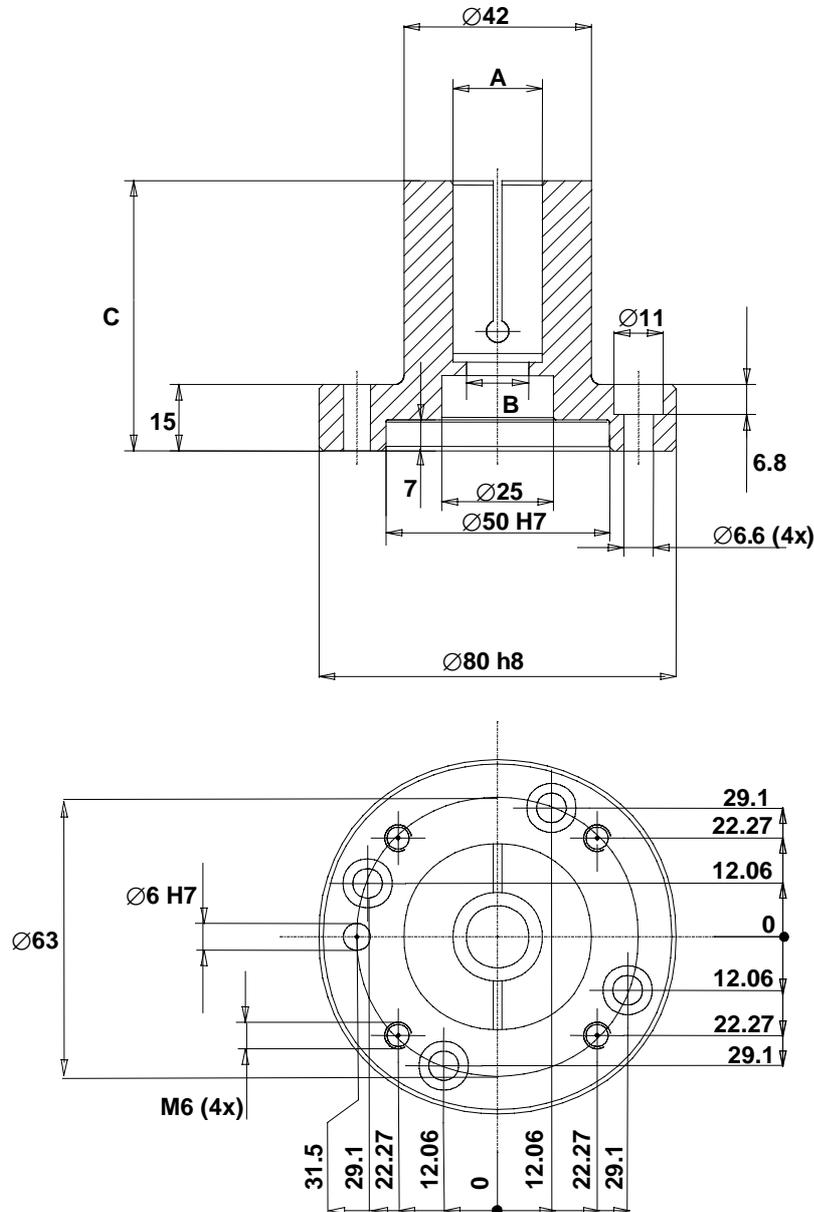
	Standard	Option
A	⌀20	⌀25
B	⌀14	⌀18

Bellows	C
with; H = 200	100
with; H = 400	125
without	61

3.2.7 Driveless teaching (optional, in the making)

With this option it is possible to bring the robot flange into the desired position and to activate the brakes of the axes 3 and 4 directly on the robot with switches. This can move the robot out of an area or teach points without the drive. The controller must be on in order to activate the brakes.

3.3 Mounting of periphery

On turboscara SR6/SR8 it is possible to mount attachments on the left and right sides of arm 2. For this purpose there are 4 threaded holes M5 (2 right, and 2 left) on arm 2.
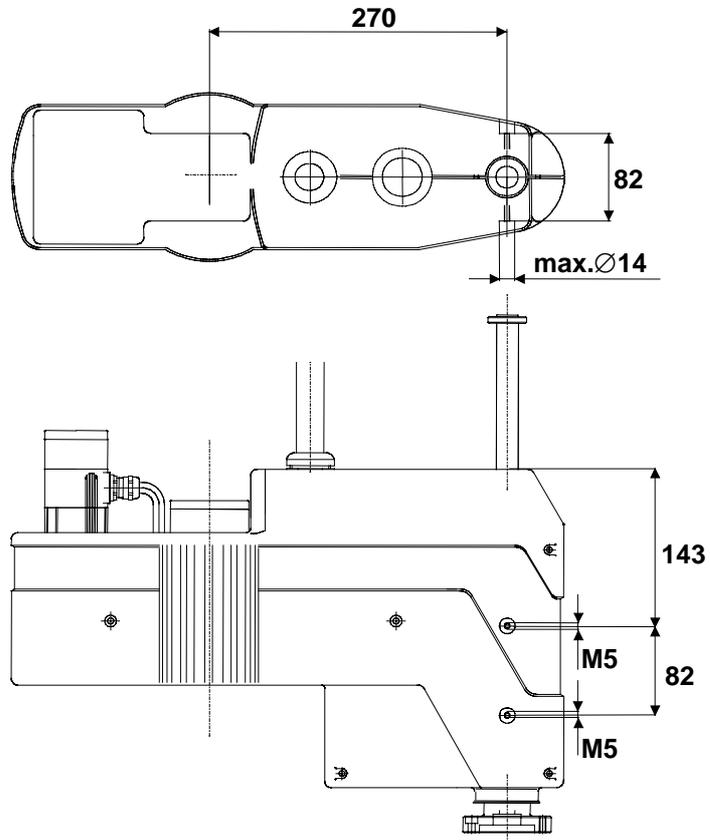
Make sure that the entire load capacity of the robot with all of its attachments, grippers, and workpieces does not exceed 5 or 8 kg.

Technical data of the robot

Load capacity, reaction forces and reaction moments	SR6/SR8	
Rated load	**2**	kg
Maximum load (Sleeve ∅20 mm)	**5**	kg
Maximum load (Sleeve ∅25 mm)	**8**	kg
Rated maximum mass moment of inertia (Axis 4)	**500**	kgcm^2
Max. mass moment of inertia (Axis 4)	**1000**	kgcm^2
Horizontal force, continuous/max.	**60/150**	N
Vertical force, continuous/max.	**200/300**	N
Torque (Axis 4), rated/max.	**5/10**	Nm

Positioning range, x, y, z	SR6/SR8	
	± 0,025	mm

Orientation range (Axis 4)	SR6/SR8	
	± 0,05	°

Work area	SR6	SR8	
Reach	**600**	**800**	mm
Inside radius	**167**	**183**	mm
Swivel angle (Axis 1)	**+/-140**	**+/-140**	°
Swivel angle (Axis 2)	**+/-150**	**+/-155**	°
Lift (Sleeve ∅20 mm)	**200**	**200**	mm
Lift (Sleeve ∅25 mm, Optional)	**200**	**200**	mm
Lift (Sleeve ∅25 mm, Optional)	**400**	**400**	mm
Swivel angle (Axis 4)	**+/-180**	**+/-180**	°

Maximum velocities	SR6	SR8	
Axis 1 + 2	**5,9**	**6,3**	m/s
Axis 1	**350**	**290**	°/s
Axis 2	**480**	**360**	°/s
Axis 3 (Sleeve ∅20 mm)	**1600**	**1600**	mm/s
Axis 3 (Sleeve ∅25 mm)	**1200**	**1200**	mm/s
Axis 4	**1200**	**1200**	°/s

Cycle time (Cycle 25-300-25)	SR6	SR8	
	< 450	**< 490**	ms

User installation	Standard up to arm 2	Up to gripper flange	
		Sleeve ∅20	**Sleeve ∅25**
Digital inputs	**8**	**8**	**8**
Digital outputs	**8**	**8**	**8**
Analog outputs	**4**	**-**	**-**
Pneumatic lines	**2 x LW4**	**2 x LW2**	**2 x LW4**

Weight	SR6	SR8	
With stand	**48,5**	**51**	kg
With bracket	**40,2**	**42,7**	kg

Protection type	SR6/SR8 Standard	SR6/SR8 Dust proof
	IP 54	**IP65**

4 IQ 200 controller

The IQ200 robot controller was designed to control the Bosch swivel-arm robots turbo*scara* SR6/SR8. With its expanded capabilities in parallel processing, even additional tasks can be solved, as for example periphery controlling, diagnosis, operator guidance and much more.

The IQ200 is a high-performance PC controller with a Pentium MMX processor and intelligent power boosters whose processor can perform position controlling in 62,5 µs cycles.

The controller is programmed with the pascal-like BAPS3 programming language. The real time operating system enables the parallel controlling of separate kinematics, cell periphery, and other processes. Data exchange with other computers, vision systems, or similar sensor systems via interfaces are also possible from the user program. Several data transfer protocols are available for this data exchange, including TCP/IP protocol.

With the interfaces DDE (**D**ynamic **D**ata **E**xchange) and DLL (**D**ynamic **L**ink **L**ibrary), the data exchange between the user process and Windows applications is standardised. Aside from the production of your own process interfaces, remote control functions and status queries can be made via Windows applications.

A high performance storage programmable controller (SPS) is available via the integrated interface modification controller PCL. This controller is standardly used to internally control the system.

IQ200 provides for all required power supplies. An additional, non-controlled power supply with 24 V_{DC}/4 A is available for the system's periphery. The electrical connections are created with plug or clip technology.

4.1 Components

4.1.1 rho4.1 controller computer

Plug-in card rho4.1
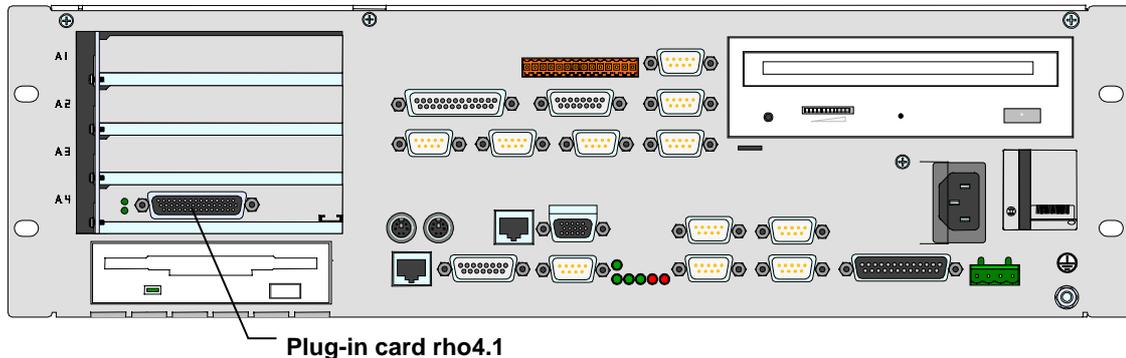
Processor

The rho4.1 has a high-performance Pentium microprocessor, a 4 MB user memory for BAPS programs and a 16 MB memory for Windows applications. The microprocessor is sectioned into 2 virtual processors P1 and P2.

The processor P1 is the BAPS3 language processor. It interprets the commands and plans the course of action and paths for the robot motion: up to 11 points in advance. In addition, the P1 processor is responsible for intelligent systems, e.g. vision systems, host computer, etc, the I/O handling of the freely programmable real time loop PCL, as well as the exchange of information with the operator via Windows interface.

The task of the P2 processor is to continually calculate each set position of the axes in path operation, i.e. to perform a transformation of the co-ordinates from space co-ordinates to axis co-ordinates. It monitors the work space limits or the axis limits and maintains the digital position control via CAN (**C**ontroller **A**rea **N**etwork).

Interfaces

The rho4.1 has PC interfaces and real time interfaces.

The PC interfaces are provided by the PC of the rho4.1.

- Four serial PC interfaces: COM1 to COM4 (COM4 is for the power supply (USV))

- A parallel interface: LPT1

- A Network interface: Ethernet

The real time interfaces are provided directly from the rho4.1 plug-in card.

- Four serial interfaces: V24_1 to V24_4

- Two CAN interfaces: CAN1 and CAN2

- An incremental interface/measurement interface

V24_1 and V24_2 can also be used as a serial 20mA interface.

There are four virtual TCP/IP interfaces WIN1 to WIN 4 available. These interfaces can be reserved and parameterised depending on the application.

Incremental Interface

Maximum permitted input frequency	800 kHz
Minimum flank distance between active counting pulses	≥ 250 ns
Input resistance	120 Ω
Minimum voltage difference	≥ 600 mV
Maximum cable length	20 m with an internal power supply and maximum 350 mA
Sensor power supply	5 V ± 5 %; in case of a short circuit, the PC shuts down completely
Maximum permitted sensor current consumption	350 mA

Longer cables can be used via the external power supply of the sensor. The possibility of a limit depends in this case on the specifications of the sensor.

Measurement input

Fast 24V input, galvanically separated, OPTO photo coupler.

Voltage range 0	-3 V to 5 V maximum 0,5 A
Voltage range 1	11 V to 30 V 4 mA to 30 mA
Switching response time (delay)	maximum 1.5 µs

CAN interface

Maximum transfer rate	1 MBaud
Maximum cable length	25 m with 1 MBaud 200 m with 128 kBaud
Data driver	short circuit protected, ungalvanized, separate
Bus terminator	120 Ω internal, not disconnectable

V_24 interfaces per RS232C channel 1, 2, 3, 4

Maximum transfer rate	19200 kBaud
Maximum cable length	15 m
Data driver	short circuit protected, ungalvanized, separate
Handshake signals channel 1,2	DSR, DTR
Handshake signals channel 3,4	none

Active 20 mA interface channel 1, 2

Maximum transfer rate	19200 kBaud
Maximum cable length	100 m
Data driver	short circuit protected, ungalvanized, separate idle speed voltage: 12 V internal resistance: 464 Ω short circuit current maximum: 26 mA
Receiver	low is recognised up to 4,5 mA high is recognised from 7,5 mA and up
Handshake signals channel 1,2	none channel 1 has a 20 mA control signal (RTS) for the connection of a PHG

Machine parameters

Individual parameters can be changed by the operator via the programming system ROPS4 (ROPS4 is pre-installed on the integrated PC), via the MP tool or via a special **m**achine **p**arameter **p**rogram (MPP) with the PHG2000.

4.1.2 Power supply EVS

The EVS offers the necessary supply of power for the IQ200 and the periphery. It fulfills the safety category 3 according to EN 954. The IQ200 system signals for the operating block, the reference points, the release, the user signals, etc. are distributed via prefabricated connector cables. The ground cable can be found underneath and to the right. The EVS also has a completely wired emergency switch in the two-channel version for the protective doors. Integration of further emergency switches for higher order systems is possible. In addition, it has the switch technology for operation with open protection doors.
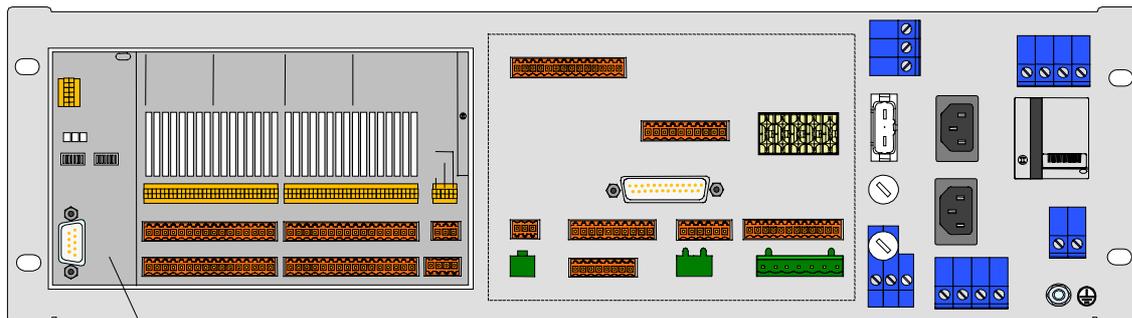
B~IO Module (not included in the standard scope of delivery)

The EVS module is arranged between rho4.1 and AV200. A 24 V_{DC} is available for user signals at the XE9 connector. This power supply is non-controlled and can be loaded up to a maximum of 4 A.

An external primary fuse (16 A, delay action fuse) is necessary for the operation of the IQ200/EVS. This fuse does not come in the scope of delivery!

4.1.3 AV200 drive booster

The IQ200 drive unit consist of a card rack that holds the servo power supply, the four booster cards Servodyn-D and final stage assembly. The data transfer between the individual booster cards and the rho4.1 control module occurs via digital drive interface CAN (**C**ontroller **A**rea **N**etwork).
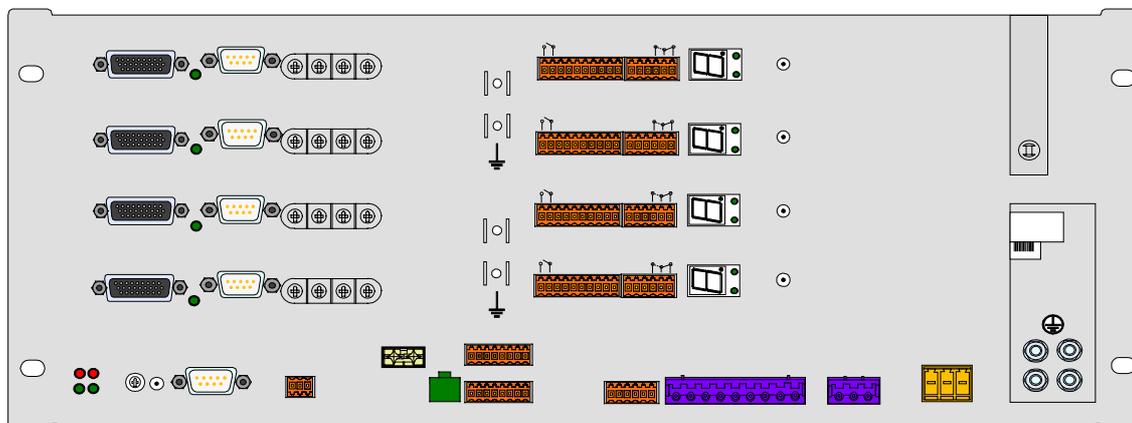
The power supply for the logic voltage of the drive unit is gained from the IQ200 power supply unit. The provision of the required intermediate circuit voltage for the power stage occurs via the servo power supply, which is standardly supplied in single-phase via the X50 interface

4.2 Technical data of the controller

External dimensions (rack)	w = 19" (482.6 mm) d = 300 mm h (rho4.1) = 3 HE ⎫ h (EVS) = 3 HE ⎬ overall = 10 HE h (AV200) = 4 HE ⎭ (444.5 mm) 100 mm of installation space should be planned in front of the rack for wiring!
Power supply	230 V_{AC}, 50/60 Hz, max. primary fuse 16 A
Power consumption	2 kVA
Interfaces: on turbo*scara* SR6/SR8 on arm 2 - digital inputs - digital outputs - analog inputs real time interfaces TCP/IP PC-Interfaces - serial - parallel - Ethernet	 8 (SRCAN, arm 2) 8 (SRCAN, arm 2) 4 (SRCAN, arm 2) 4 (V24_1 to V24_4) one for the PHG2000 4 (WIN_1 to WIN_4) 4 (COM1 to COM4) one for the integrated USV (power supply) and one for the touchscreen 1 (LPT1) serial high-speed network interface
Processor	Intel Pentium MMX, 200MHz
RAM	32 MB, optionally 64 MB or 128 MB
Software/Programming	BAPS3 language, any PC software for Windows
Power supply for process periphery	24 V_{DC}, 4 A, uncontrolled according to DIN 19 240
Degree of protection	IP20, IP54 in control cabinet
EMV interference immunity	DIN/EN 50081 part 2
EMV interference emission	DIN/EN 50082 part 2
Number of boosters	4 boosters in the drive unit AV200
Drive performance	for turbo*scara* SR6/SR8
Operating temperature	5 to 45 °C

Notes

5 Accessories

5.1 turbo*scara* SR6/SR8

5.1.1 Tool Connector

The Tool Connector (TC) has user I/Os and even 5/2 directional control compressed air valves directly on the gripper flange. The cables/lines are completely integrated into the robot. The TC enables ultra-short cycle times via the short supply line between the valves and the gripper. It also enables a simple and fast application and start-up via the clear installation procedure.

The TC has 5 inputs and 8 outputs. The user installation guides the 8 inputs and 8 outputs through the turbo*scara*'s sleeve down to the TC. 5 inputs and 8 outputs are connected directly to the TC. The 3 additional inputs are available on a separate plug.

The mounting of the Bosch gripper PPG11/21/31 is achieved very quickly with intermediate flanges.

Technical data

Housing dimensions	94×78×80 mm
Overall dimensions	94×127×80 mm
Interference circle diameter	155 mm
Weight	0.85 kg
Power supply	24 V, 0 V,PE
Max. current	2 A
Degree of protection	IP54
Outputs	8
Inputs	5
Operating pressure	1.5 to 7 bar
Compressed air	filtered 5 μm
Rated flow per valve at 6 bars	96 l/min
Valve switching response time	< 15 ms
Switching frequency	5 Hz

Cross-section drawing

Gripper flange

Robot flange

5.1.2 Pneumatic parallel gripper

2-finger parallel gripper
Types PPG11, PPG21, PPG31

- Directly connectable to the turbo*scara* SR6/SR8 via an intermediate flange

- Very compact due to the integrated drive in the housing

- Very light due to the use of high tensile aluminium

- Gripping power spring lock when used as external gripper

- High gripping power due to wedge hook kinematics

- Good guide characteristics via flat guiding

- Centric and parallel gripper motion with fixed gripping jaws

- Air connection and gripper mount from 3 sides

Technical data

Actuation	pneumatic
Compressed air	filtered (10 μm) and oiled
Operating pressure	min. 5 bar, max. 6,5 bar
Installation position	any
Operating temperature	5 to 60 °C
Repetition accuracy	approx. 0,05 mm

Type	A	B	C	D
	mm	mm	mm	mm
PPG11	64	36	56	52
PPG21	80	42	69	64
PPG31	100	50	80.5	80
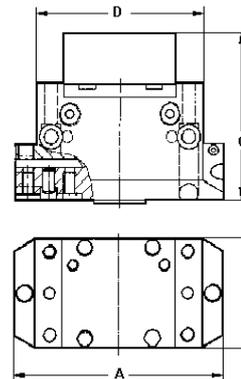
Type	Mass	Lift per jaw	Weight of work-piece	Gripping power lock through spring (standard value)	
	kg	mm	kg	min. N	max. N
PPG11	0.62	6	1.2	90	170
PPG21	1.11	8	1.8	150	250
PPG31	1.74	10	2.8	210	330

5.2 IQ 200 controller

5.2.1 Operating block
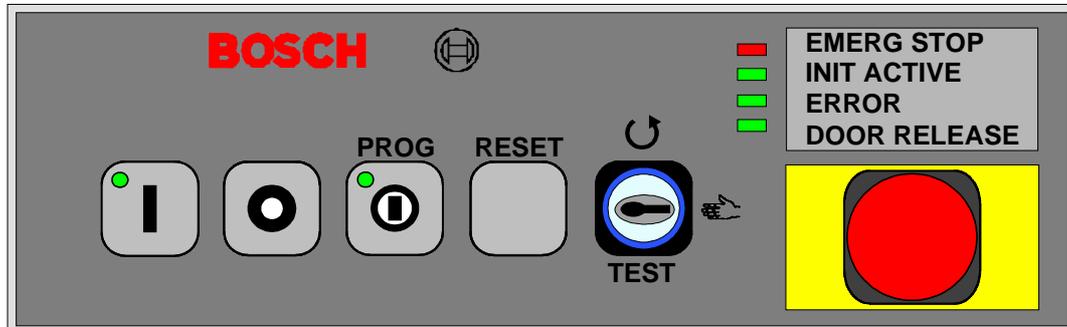
The operating block with its switches and LED enables the operation of the basic functions of the IQ200:

- Mode selection (automatic / hand / test operation)
- Start, stop and continuation of user programs
- On and off switching of the drive performance
- Reset
- Display of operating conditions
- Emergency switch

Installation dimensions (Door section)
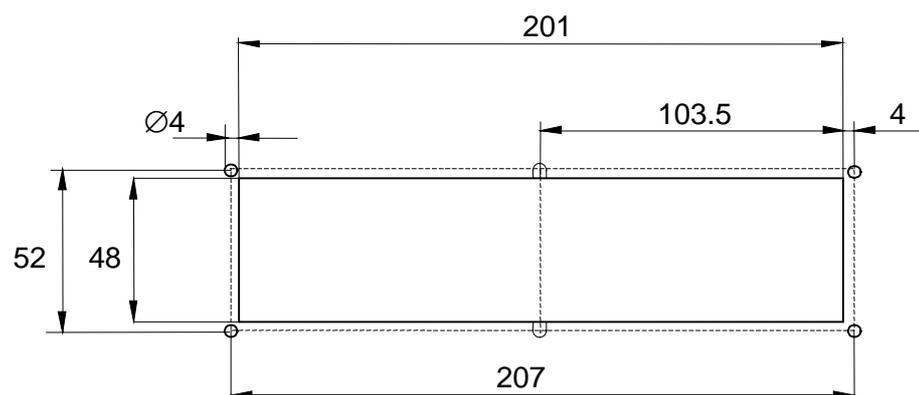
5.2.2 Touchscreen BF200T

Touchscreen for programming, operating and visualising
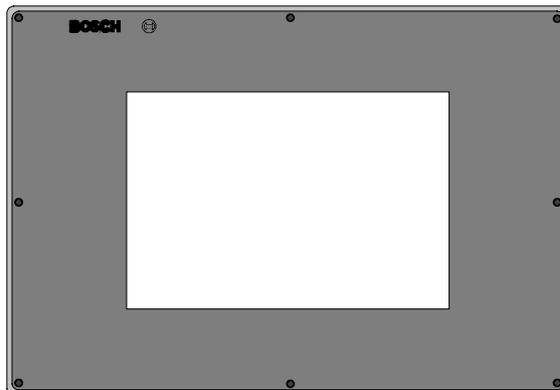
The BF200T touchscreen performs all display functions required for pro-gramming, operations and diagnosis.

Equipment

- 10.4" TFT colour display
- 600 x 480 pixels
- Touchmouse driver
- Touchscreen controller

Installation dimensions
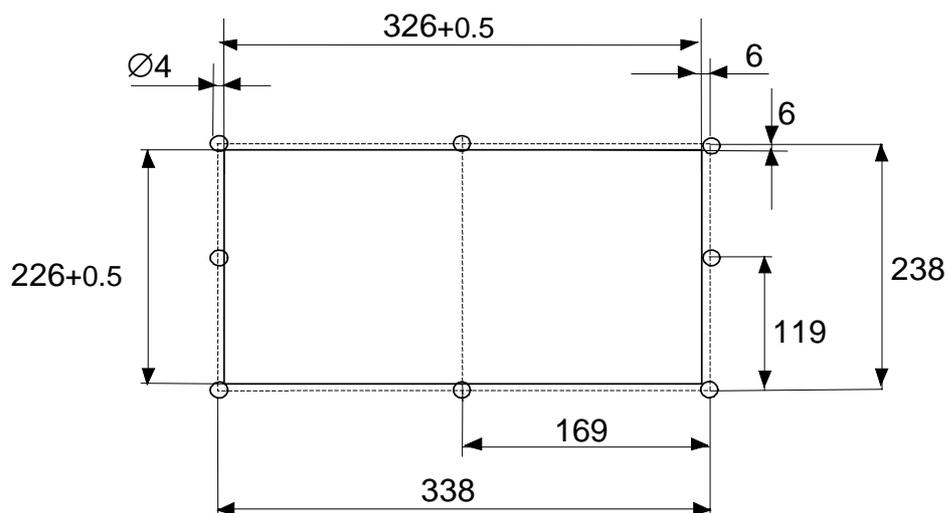
5.2.3 PHG2000 hand-held programming device

BAPS3 programs can be constructed and tested directly on the controller with the PHG2000. Furthermore, data from an application program can be displayed or inquired. The following operational functions can also be carried out:

- Travel to the reference points

- Manual movement of the axes

- Teaching of points in the work space

- Diagnosis

- Parameterisation and much more

The PHG2000 is equipped with its own microprocessor. You can make your own masks and menu levels. As a further characteristic the rho4.1 system variables can be accessed with the PHG2000.

The PHG2000 is also equipped with a two-channel emergency switch and a two-channel confirmation button. When motion functions are performed in manual mode, the confirmation button is monitored additionally by the real time operating system. With corresponding additional measures it is thus possible for the robot to be moved in the test mode even when the protective door is open.

If the PHG2000 is not connected, it must be removed from the system or its emergency switch will not function.

5.2.4 Software

The following software are available as accessories

- ROPS4/Online

- DDE-Server 4

- WinSPS

- WinDP / WinCAN

ROPS4/Online

ROPS4/Online enables the creating, testing, and archiving of programs for the rho4 controller. The program can be run with Windows95 or WindowsNT. The use of a mouse is not required, but is recommended, since this makes it more comfortable for the operator. ROPS4 is protected against unauthorised copying. A software license is required to operate ROPS4.

ROPS4/Online has the following functions:

- BAPS plus: A structure-oriented program system with which sequencing programs can be quickly and easily created, documented and tested in top-down design. The important advantage of this expansion lies in the automatic code generation and in the possibility to observe the process. The program course is arranged in the form of a program course plan constructed of picture symbols.

- Machine parameter converter: Readable and alterable ASCII files *.amp can be made from machine parameter files *.bin with the help of the converter. Another part of the converter alters ASCII files into machine parameter files which can then be loaded into the controller.

- Integrated BAPS translator translates the created motion programs with help of the ASCII editor.

- Program archiving (load, save, list, delete, name etc.)

- Remote control functions: program start, display of axis position, I/O status etc.

- Coupling functions: transfer of files from/to rho4, connection to the rho4 via serial interface or TCP/IP.

- Offline/online points editor.

- Process functions: process selection, process start, process stop etc.

DDE Server4

The DDE Server4 connects rho4.1 to Windows.

The software package ROPS4 offers many functions to communicate with the rho4 controller: data transfer, process and status functions. In the following they are also called online functions. These services are put together in a program package equipped with a comfortable graphical user interface and can be run with Windows95 and WindowsNT.

A function library with a normalised interface is required to give the user the possibility to integrate the online functions into his own user interface or into the rho4 with Windows remote control, i.e. without the use of the PC.

For this integration, MS Windows has inter-process communication **D**ynamic **D**ata **E**xchange. In order to exchange data between two Windows applications, one of them must serve as client (e.g. the user interface) and the other as server (DDE-Server4).

The DDE Server4 offers several services for this communication which can be used by the client. These services are used to set up connections, exchange data, monitor, execute and much more. This data exchange can be separated into one-time transfers (e.g. process start) and dynamic data exchanges (e.g. axis display). All functions for the process communication are located in the library DDEML (**D**ynamic **D**ata **E**xchange **M**anagement **L**ibrary). In general the client and server can only communicate via these functions.

WinSPS

The integrated software SPS (PCL) can be programmed with WinSPS. As a future programming tool WinSPS offers the famous Windows Look & Feel for instruction lists (AWL), operation language (AS), function plan (FUP) and contact plan (KOP).

Optionally, a WinSPS license can be directly ordered when ordering the robot system. This license contains:

- Basic WinSPS license

- License for the PCL

- License for the central programming (enables the SPS programming on another computer that is connected with the rho4.1)

WinDP/ WinCAN

WinDP or WinCAN serve to configure the inputs and outputs which are connected to the optional PROFIBUS DP master card or CANopen card.

GateWay

GateWay is part of the standard scope of delivery.

GateWay is a Windows application for Windows95 or WindowsNT. It serves the TCP/IP communication between the rho4.1 and all external clients and Servers.

IP address and port number

A TCP/IP address consist of 2 components: the IP address of the computer (host) and a port number. The IP address is the world wide definitive address of the PC. The address is comparable to a normal house address with country, city, street and house number. The port number is the number of a server or client on the computer. This is comparable to the name of the person at the address. The port numbers 6000 to 6200 and 5000 to 5200 are reserved for Bosch.

Establishing a connection

GateWay can be started after the controller is up and running.

During the initialisation GateWay builds a TCP/IP link to the corresponding server for all adjusted connections in the file GateWay.ini. At the same time a GateWay server branch is started for each of these connections. It is available for the linking of a client. Since GateWay runs under the Windows part of the PC, the IP address is the IP address of the physical Ethernet card.

5.2.5 Licensing the software

Software requiring a license:

- ROPS4/Online
- WinSPS (Basic package + PCL + central programming)
- DDE-Server4
- WinDP / WinCAN

As an option, software licences can be ordered directly with the robot system.

You can also order the individual software licences from the AST department (drive and controller technology). The software installation data are already in the rho4.1. You can find a fax form under the menu item 'License application' of each software. Using this fax form, you can apply for the license, see point 7.3.6.

5.2.6 I/O-Module

You will find more information on I/O expansion in paragraph 6.7.

B~IO module (Bus~I/O Module)
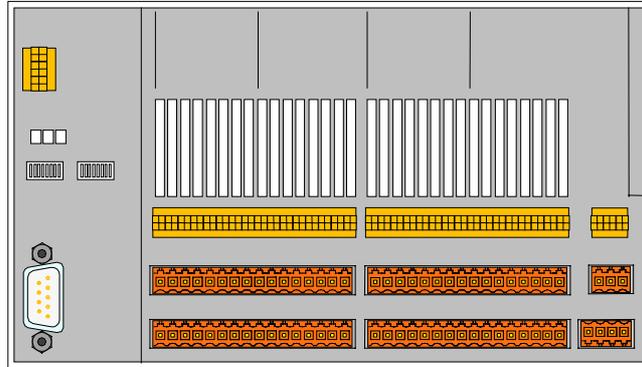
The number of available inputs and outputs can be extended with the IQ200 via a decentralised I/O module.

Bosch has suitable modules in various versions available. The inexpensive, compact B~IO versions offer all common combinations of input and outputs and they integrate the field bus switch. There are also modular B~IO versions with analog I/O combined digital outputs or with relay combined digital outputs. These can be delivered from Bosch AT/AST Erbach, Germany.

The compact **B~IO K–16DI/16DO** can be ordered with 16 digital inputs and outputs already installed.

VTS02 valve block system
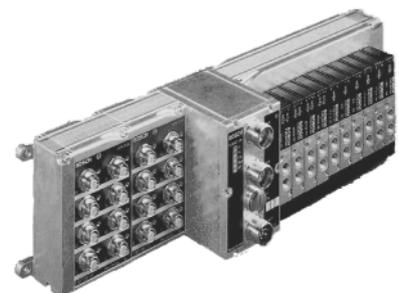
The VTS02 valve block system is a flexible modular system for achieving your pneumatic tasks. 3/2, 5/2 and 5/3 directional control valves can be combined at will on a maximum of 16 valve positions. The electrical controlling occurs via field bus system. With the CAN bus module, the VTS02 can be configured for the rho4.1 and can be hooked up to the IQ200.

5.2.7 Further bus connections

Additional bus connections can be achieved with optional plug-in cards:

PROFIBUS DP master card

PROFIBUS DP master card is a plug-in card that is built directly into the rho4.1 and is delivered already configured. With the PROFIBUS DP master card it is possible to connect I/O islands as PROFIBUS-DP slaves to the controller. The configuration of these modules is programmed with WinDP. The evaluation of the signals occurs in the PLC program.

CANopen

The CANopen plug-in card is built directly into the rho4.1 and is delivered already configured. With this card it is possible to connect CANopen I/O islands to the controller. The configuration of these modules is programmed with WinCAN. The evaluation of the signals occurs in the PLC program.

InterbusS (in the making)

The InterbusS plug-in card is build directly into the rho4.1 and is delivered already configured. With this card it is possible to connect InterbusS I/O islands to the controller (in the making).

The B~IO modules can be set into the corresponding versions as I/O islands.

5.2.8 Control cabinet

A 19" control cabinet is available for the installation of the IQ200 components. It has a cut-out for the operating block and an installed main switch assembly. Additionally, a PE kit for the necessary ground connections is added next to the ventilation assembly.
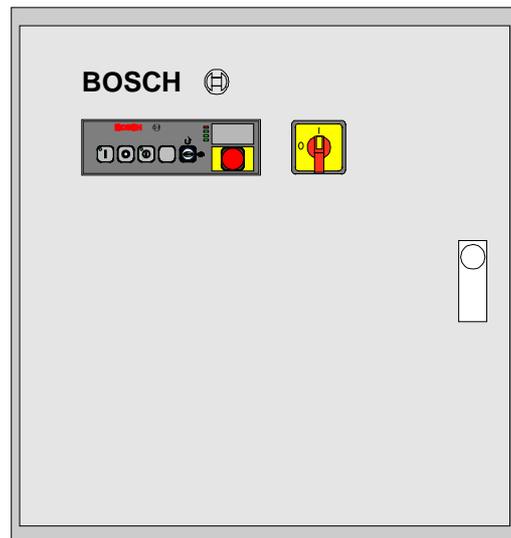
External dimensions

- Width: 600 mm
- Height: 620 mm
- Depth: 600 mm

Degree of protection   IP54

The control cabinet can be delivered individually.

The operating block is not a part of the control cabinet's scope of delivery!

6 Layout criteria

6.1 Load capacity

Load is defined as all attached mass (e.g. gripper, workpiece, tool) on the flange surface as well as attached periphery on arm 2.

The sum of all individual masses must not exceed the permitted overall load!

Load capacity	➢	*5 or 8 kg*

6.2 Mass moment of inertia

The effective mass moment of inertia around the fourth axis is a combination of the moments of inertia of the individual masses attached to the flange surface.

Under no circumstances is the maximum value to be exceed!

Maximum mass moment of inertia	➢	*1000 kg cm^2*

6.3 Reaction forces

The permissible effecting forces on the robot are dependant on various factors of influence: duration of effect, direction of force, and the distance from the flange's upper position.

Exceeding the given values can lead to mechanical or thermal overload of the robot!

Maximum horizontal force	➢	*150 N*
Maximum vertical force	➢	*300 N*

6.4 Permissible load at gripper flange

The diagram contains the permissible transverse forces acting on the lift/rotation axis. A distinction is made between the continuous value and the maximum value:

- The continuous value arises out of the permissible thermal stress on the motor. If the continuous value is exceeded for a significant length of time, the drives shut down. This, however, does not lead to any damages of the device.

- The maximum value takes into account the maximum torque of the motor and the permissible loading capacity of the bearings. If this value is exceeded, it leads to large positional deviations in the X Y planes and the drives shut down after approx. 2 seconds. Repeatedly exceeding the maximum values will cause damage to the device.
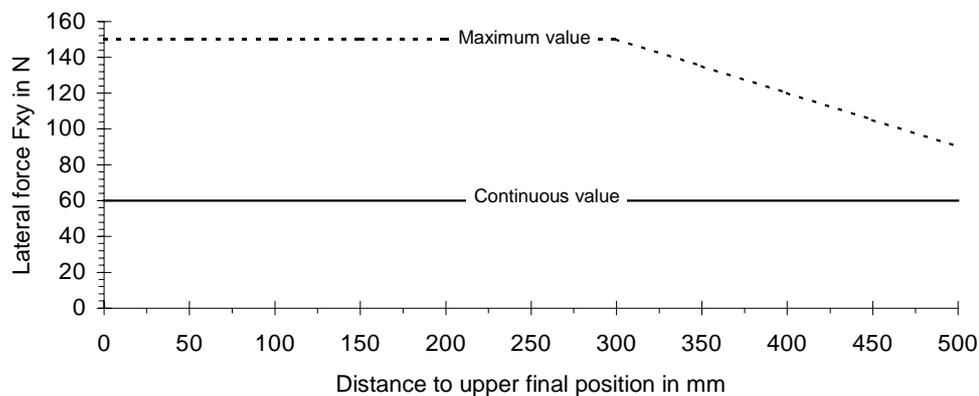
6.5 Working area

The working area shown in the dimensioned diagrams is valid for the Tool Center Point: the center of the flange surface. During the layout, take into consideration that attachments and bulky tools do not cause collisions with the robot stand. If this should be the case, you can limit the working area via the software limit switch.

Observe the working area limits when making constructions!

6.5.1 Planning sheet for the SR6
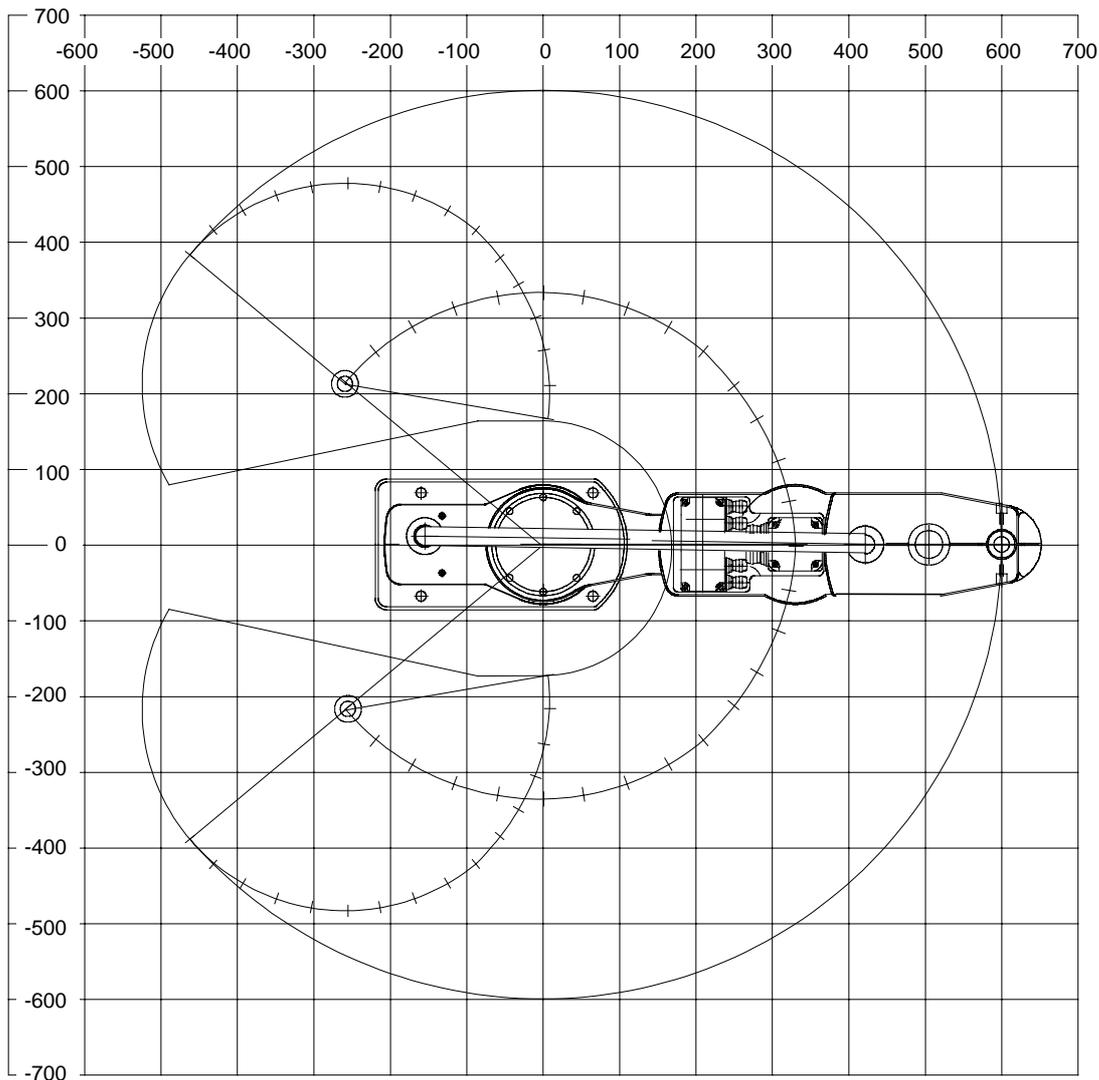
Swivel angle: Lift: M 1 : 10

Axis 1: ± 140°   Axis 3: 200 mm

Axis 2: ± 150°

Axis 4: ± 180°

6.5.2 Planning sheet for the SR8

Swivel angle: Lift: M 1 : 10
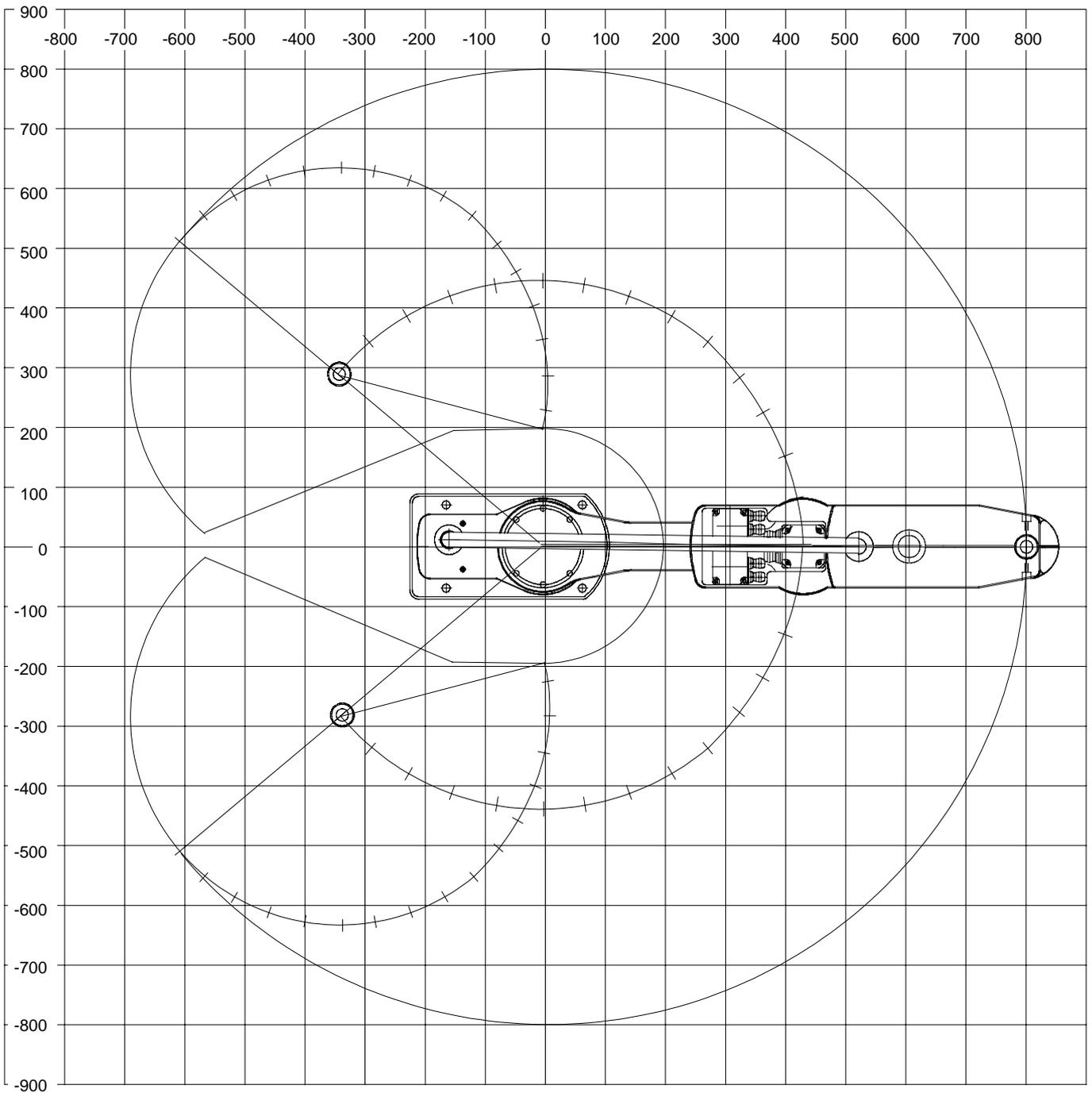
Axis 1: ± 140°   Axis 3: 200 mm

Axis 2: ± 155°

Axis 4: ± 180°

6.6 Cycle time

The adherence of the required cycle time can be determined with help of the diagrams on the following pages. When making determinations, do not forget that the cycle time is a combination of the travelling time and the process times (e.g. gripping times) and that not every process allows for the maximum acceleration and velocity. When a swivel arm robots is in motion, very high angle accelerations can occur which can cause, for example, the workpiece to be pulled loose from the gripper.

6.6.1 Cycle time determination

Procedure

- Determine the initial position and final position for each individual axis and from that, the distance travelled.

- Read off the corresponding travelling time from the diagrams for the determined path distance. When the motions of several axis overlay each other, the longest travelling time is valid.

- Determine the total travelling time by adding together the travel times in the sequence.

- Now add 0.06 s positioning time for each exact position to be moved to, e.g. with BAPS command ‚Move to point'.

- Finally, only the process times (gripping time, etc.) must be taken into account. Typical process times, e.g. time to close the gripper, lie between 0.15 and 0.3 seconds. This value comprises the reaction time of the valve, the build up of pressure up to the gripper, and the movement of the gripper. Since gripper processes are frequent, there is a large potential for optimisation here. For example, by arranging the valves at the gripper (installation of the Tool Connectors on the robot flange). The use of vacuum suction technology proves to be advantageous, since once the vacuum has be activated, the process times for the gripper are almost negligible.

- A further possibility to save cycle time exist with spatial passing. The normal pick-and-place procedure (see figure) has the following affect on the movement process. As a result of the 'move via' command, the points P2 and P3 will be passed within the zone defined by R.
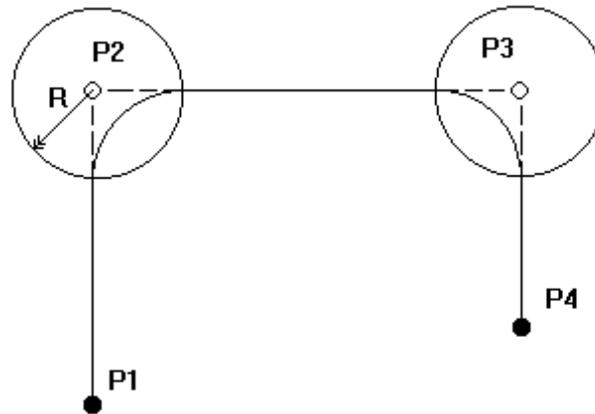
In practice, the driving time of the third axis is usually responsible for how much driving time is saved. In this case the following can be generalised: depending on lift and defined passing area, a saving of up to 50% of the drive time of the third axis can be achieved. When determining the passing area, existing interferences (edges of pallets, boxes, crates) in the path must be taken into account!

This procedure permits a rough estimation. However, valid and binding statements on cycle times can only be made after testing under realistic conditions, since it is often the peripheral processes that can significantly influence the cycle time of the entire station.

6.6.2 Cycle time diagrams

turbo*scara* SR6
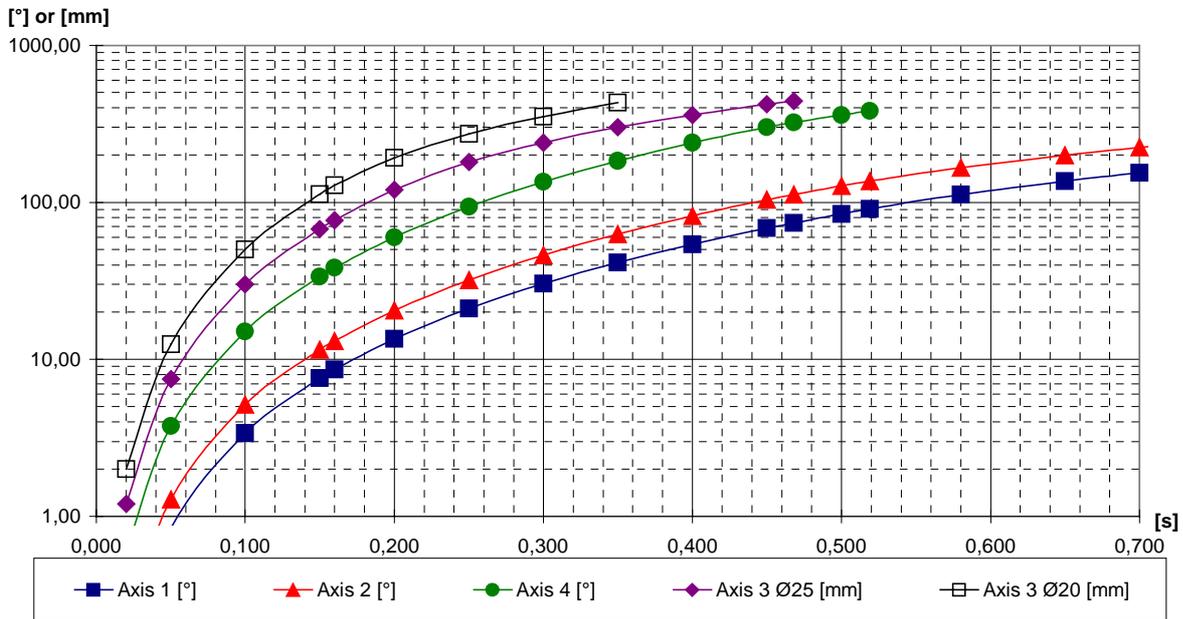
turbo*scara* SR8
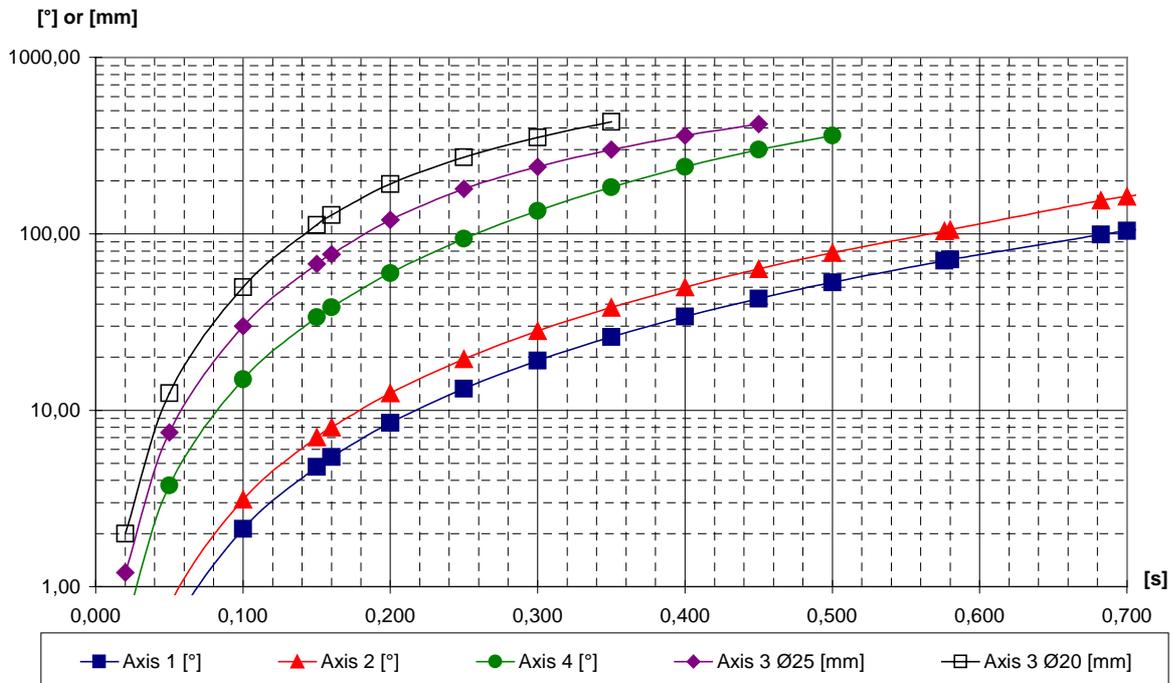
6.7 I/O expansion

The standard robot system provides the following configuration:

- 8 digital inputs

- 8 digital outputs

- 4 analog inputs (10 bit in SPS programs, 8 bit in BAPS programs)

16I and 16O are additional provided with the optional "B~IO module 16I/16O in the controller".

The I/O configuration can be further expanded by the customer (e.g. further B~IO modules, see product program AST, drive and controlling technology):

- The maximum number of CAN I/Os in the SPS program is 48 bytes inputs and 48 bytes outputs, whereby a digital input or output takes up 1 bit and an analog input or output takes up 2 bytes.

- Up to 199 inputs and 199 outputs or 8 analog inputs and 16 analog outputs can be addressed in the BAPS program.
  The following are standard in the SPS program for BAPS programs:

  - 199 CAN I/O for BAPS
  - 4 analog inputs on the SRCAN modules in arm 2, filtered to 8 Bit.

- When making a layout with a larger number of I/Os, the configuration of the B~IO modules must be taken into account (maximum number of junctions on the CAN2).
  Please contact your system integrator when performing this.

- When making configurations with an additional bus card (PROFIBUS-DP master, CANopen, InterbusS (in the making)), an additional 16 byte I/O is available. This number can be expanded by upgrading the PCL version from PCL-S to PCL-L or PCL-X :

  - PCL-S: 16 byte I/O   16K instructions in AWL
  - PCL-L: 256 byte I/O   64K instructions in AWL
  - PCL-X: 8192 byte I/O   128K instructions in AWL

  The configuration of the modules occurs with WinDP, the evaluation with WinSPS.

6.8 Ambient conditions

Ambient conditions must be considered in order to receive the full function-ality with the given technical data. Observe the given temperature rages. Provide for a shock-reduced set-up. Protect the system from contact with aggressive substances and from condensation.

If the robot will be used in severe conditions, e.g. in areas with machine tools, it is recommended to use the option with bellows for the sleeve in or-der to protect the sleeve from wear and tear.

Temperature	➢	*10 to 40 °C*
Dirty, wet working conditions	➢	*Option with bellows or dust proof variation*

6.9 Other marginal conditions

Inputs and outputs

Reserve inputs and outputs should be planned in during the layout of the controller.

Stand/Bracket

Choose the position of the stand/bracket so that devices, which lead in and out, and the robots own working area are positioned within reach. This re-duces the swivel angle and minimises the cycle time.

Stand length	➢	*Standard 500 mm*
Stand length	➢	*Optional 250 to 700 mm*
Bracket for mounting on the wall	➢	*Optional*

Connection cable

Make sure that the cable length between robot and controller is sufficient. Aside from a fixed cable 'tail' variation, there is also a variation with a plug. In addition, the cable can be led to the back out of the stand or through the base plate.

Cable 'tail'	➢	*Standard 2 m*
Cable with plug	➢	*Optional 6 m, 10 m, 20 m*

User installation

Interfaces for user installation are offered as standard in the installation area of arm 2. If these are needed on the gripper flange, this can be achieved via an optional installation in the sealed cable pipe and via the sleeve up to the gripper flange.

Interfaces in Arm 2	➢	Standard
Empty pipe without cable	➢	Optional
Installation up to gripper flange	➢	Optional

7 Ordering

You can use the following sheets to order a Bosch robot system. They contain all standard components, options, accessory parts and documentation.

7.1 Notes on ordering

- Mark the desired components in the column to the right with an X.

- In case you would like to order a variation of the standard, mark an X in the box for 'with the fixed options listed below' and then choose the options in the 'options' table with an X.

- If a choice of measurements is given, choose the desired values.

7.2 Example

Robots	Order number	
turbo*scara* SR6, Standard	3842 999 835	
turbo*scara* SR6 with the fixed options listed below		
turbo*scara* SR8, Standard	3842 999 836	
turbo*scara* SR8 with the fixed options listed below		X
turbo*scara* SR6 dust proof	3842 999 849	
SR6 dust proof with the fixed options listed below		
turbo*scara* SR8 dust proof	3842 999 850	
SR8 dust proof with the fixed options listed below		

Options for the turbo*scara* SR6 / SR8	Dimensions	
Stand length 250, 300, 350, 400, 450, 550, 600, 650, 700	350	X
Bracket instead of stand		
Sleeve with ∅ 25 mm, Lift 200 mm, 400 mm	400	X
Lift 600 mm (only with agreement!)		
Connecting cable with plug, 6 m, 10 m, 20 m	10	X
Empty pipe up to sleeve for the user installation (not with dust proof!)		X
Installation kit up to flange		
Bellows around sleeve (already included with dust proof!)		

7.3 Order forms

7.3.1 Robot system complete

Standard scope of delivery

Robot:

- Stand length 500 mm

- Sleeve (Axis 3 and 4) with $\varnothing$ 20 mm

- Lift (Axis 3) 200 mm

- Fixed connecting cable 2 m

- User installation:
  Interfaces on Arm 2:
  8 inputs / 8 outputs / 4 analog inputs

Controller:

- rho4.1

- EVS

- AV200

- Cable kit

- 19" Rack

Installed software (in German)

- Windows95

- Software-SPS PCL-S

- Winrho

- rho4 SW functions

- GateWay

- ROPS4/Online (without licence)

- DDE-Server4 (without licence)

- WinSPS (without licence)

- WinDP (without licence)

Documentation:

- CD-ROM with full documentation

- Start-up guide, safety instructions and blue prints in printed form

System	Order number	
turbo*scara* SR6 with IQ200, Standard System with the fixed options below	3842 999 841	
turbo*scara* SR8 with IQ200, Standard System with the fixed options below	3842 999 842	
turbo*scara* SR6 dust proof with IQ200 System with the fixed options below	3842 999 915	
turbo*scara* SR8 dust proof with IQ200 System with the fixed options below	3842 999 916	

7.3.2   Swivel arm robot turbo*scara* SR6/SR8

Standard scope of delivery (only robot mechanics)

- Stand length 500 mm

- Sleeve (Axis 3 and 4) with $\varnothing$ 20 mm

- Lift (Axis 3) 200 mm

- Fixed connecting cable 2 m

- User installation: Interfaces on arm 2

Robot	Order number	
turbo*scara* SR6, Standard	3842 999 835	
turbo*scara* SR6 with the fixed options below		
turbo*scara* SR8, Standard	3842 999 836	
turbo*scara* SR8 with the fixed options below		
turbo*scara* SR6 dust proof	3842 999 849	
SR6 dust proof with the fixed options below		
turbo*scara* SR8 dust proof	3842 999 850	
SR8 dust proof with the fixed options below		

7.3.3 Options

Options turbo*scara* SR6/SR8	Dimensions	
Stand length 250, 300, 350, 400, 450, 550, 600, 650, 700		
Bracket instead of stand		
Sleeve with ∅ 25 mm, Lift 200 mm, 400 mm		
Lift 600 mm (only with agreement!)		
Connecting cable with plug, 6 m, 10 m, 20 m		
Empty pipe up to sleeve for the user installation (not with dust proof!)		
Installation kit up to flange (for Tool Connector)		
Bellows around sleeve (already included with dust proof!)		
Driveless teaching through button for brakes axis 3/4 (in the making)		

IQ200 Options		
Operating block		
Control cabinet with main switch (order also operating block!)		
B~IO compact module 16E/16A, installed, wired, configured, with plugs		
Touchscreen BF200T includes 10 m cable, loosely enclosed		
RAM expansion from 32 MB to 64 MB or 128 MB	*64MB*	*128MB*
WindowsNT instead of Windows95 (RAM expansion to a minimum of 64 MB necessary!)		
Additional bus card		
Profibus DP Master		
CANOpen		
InterbusS (in the making)		
Software licences:		
ROPS4/Online		
WinSPS (Basic package + PCL + central programming)		
DDE-Server4		
WinDP		
Hardlock (dongle) for transferring of software licences		
(the dongle is empty when delivered)		
English language (Windows and installed software)		

The EVS, rho4.1, AV200, operating block and main switch are already installed and tested in orders with control cabinet and operating block.

7.3.4 Accessories

Component	Order number	
Tool Connector TC	3842 521 300	
Valve group 5/2 (impulse) for TC	3842 521 297	
Valve group 5/2 (air cushion) for TC	3842 521 298	
Parallel gripper PPG11	3842 517 264	
Parallel gripper PPG21	3842 517 265	
Parallel gripper PPG31	3842 517 266	
Intermediate flange for PPG11	3842 517 270	
Intermediate flange for PPG21	3842 517 271	
Intermediate flange for PPG31	3842 517 272	
Hand-held programming device PHG2000, display is not lit	1070 918 443	
Bracket for PHG2000	1070 918 445	
Menu inserts in English for PHG2000	1070 918 446	

7.3.5 Documentation

The robot's standard scope of delivery includes a slipcase with the start-up guide – a short introduction to working with the robot -, the safety instructions and the circuit diagram. In addition, it contains a CD-ROM that has, aside from all manuals listed below in German and in English, CAD data, planning instruction, and information on Bosch and its automation technology division.

The essential chapters and current changes of this CD-ROM can also be found via the Internet under the following address:
http://www.bosch.de/at/rhs .

German/English

System		Order number
Slipcase		3842 524 317
CD-ROM		3842 524 619
Start-up guide	German	3842 524 306
Start-up guide	English	3842 525 128

For additional orders of documentation write a fax:

Robert Bosch GmbH

AT/VWM1

Fax 07 11/ 8 11 - 78 95

The entire manual (CD-ROM) contains the following manuals:

	Ordering number
German	
Mechanik	3842 524 311
Robotersteuerung IQ 200	3842 524 313
Sicherheitshinweise	3842 524 315
BAPS3 Kurzbeschreibung	1070 072 412
BAPS3 Programmieranleitung	1070 072 413
Maschinenparameter	1070 072 414
Signalbeschreibung	1070 072 415
Statusmeldungen und Warnungen	1070 072 417

DLL-Bibliothek	1070 072 418
Steuerungsfunktionen	1070 072 420
PHG2000	1070 072 421
BAPS plus	1070 072 422
ROPS4/Online	1070 072 423
DDE-Server4	1070 072 433
Systembeschreibung	1070 072 434

English

Mechanic	3842 524 378
IQ 200 Robot Control System	3842 525 379
Safety instructions	3842 524 315
BAPS3 Short description	1070 072 177
BAPS3 Programming manual	1070 072 178
Machine parameters	1070 072 175
Signal descriptions	1070 072 182
Status messages and warnings	1070 072 181
DLL-Library	1070 072 176
Control functions	1070 072 179
PHG2000	1070 072 183
BAPS plus	1070 072 187
ROPS4/Online	1070 072 180
DDE-Server4	1070 072 184
System description	1070 072 185

7.3.6 Licences

When ordering a robot system, you can order licences as an option with the controller, see point 7.3.3.

You can re-order or order further licences from our AST department (drive and controller technology). For the address see point 7.3.7. You can get the necessary information for ordering licences under the menu point 'Licence application' of each software.

7.3.7 Further components from the Bosch AT program

You can order additional accessory parts from the production department AT (drive and controller technology).

- Additional or other I/O modules from the B~IO program.

- Hardlock (dongle, ordering no. 1070 919 875) for plugging on the PC parallel port. Existing crypt-key licences can be transferred to this hardlock (e.g. ROPS4/Online, WinSPS, ...).

- Hand-held programming device PHG2000, lit-up display (ordering no.1070 919 860)

Valve islands from program VT202 can be ordered from the HP department (hydraulic and pneumatic) (e.g. for addressing the valves via CAN bus CAN2 of the rho4.1).

Addresses:

> **Robert Bosch GmbH**
> Drive an Control Technology
> P.O.Box 11 62
> D-64701 Erbach
>
> Fax: 0 60 62 / 78 - 4 28
>
>
> **Robert Bosch GmbH**
> Hydraulics/Pneumatics
>
> P.O.Box 30 02 40
> D-70442 Stuttgart
>
> Fax: 07 11 / 8 11 - 89 17

8 Services

8.1 Automation technology, robot technology division

Robert Bosch GmbH

Automation Technology Division

AT/VRO

Wernerstraße 51

P.O.Box 30 02 07

D 70442 Stuttgart

Tel.: (07 11) 8 11 - 3 15 18

Fax : (07 11) 8 11 - 78 75

8.2 Sales

You will receive full support for your individual applications from our system integrators. When needed, they will lay out the complete system, program the robots and run systems for you.

Due to their many years of experience with Bosch robots, our system integrators are the right people for your needs.

You will find the Bosch sales partner nearest to you on the back side of this planning manual.

If you have any questions, please do not hesitate to call us. We are at your service!

8.3 Training

Our training center in Erbach, Germany, offers comprehensives courses for beginners and advanced users of the Bosch robot technology. All courses emphasise practical application and contain practice blocks, in which original equipment is used to practice what is learned.

Course	Subject	Duration
SR6 & SR8 Operation R4/SR6-B	Operation of the SR6/SR8 robot systems with IQ200 controller.	4 days
SR6 & SR8 Maintenance SR6-I	Maintenance of SR6/SR8 robot systems with IQ200 controller.	3 days
Advanced programming with BAPS3 R4/SR6-P	Advanced user programming with BAPS3 for robots with IQ200 controller.	4 days

For detailed information contact the training center at:

Telephone 0 60 62 / 78 - 600 or **- 602**

Address   Robert Bosch GmbH
Automation Technology Division
Didactic

P.O.Box 11 62
D-64701 Erbach

8.4 Hotline

If you have any questions on the turbo*scara* SR6/SR8 robot systems with IQ 200 controller, use our customer hotline at:

Telephone 07 11 / 8 11 - 74 97 or **78 74**

Address   Robert Bosch GmbH
Automation Technology Division
AT/VRO

P.O.Box 30 02 20
D-70442 Stuttgart

Notes

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9 Appendix

9.1 Accessories from other manufactures

On the following two pages you will find data sheets from the company Bihl + Wiedemann. These sheets describe the AS-i/CANrho Gateway and the CANrho/PROFIBUS coupler.

The data sheets are only for your information. The individual manufactures take responsibility for the guarantees of their accessory parts.

AS-i/CANrho Gateway

AS-i Gateway to CANrho

**AS-i Master
128 Bit Digital
I/O-Module for
CANrho**

**Error diagnosis
Directly at Gateway**

Article no. 1173/1174

Function

The AS-i/CANrho Gateway serves as a connection of the actuator sensor interfaces with a superior CANrho system. Gateway represents the complete master for the AS-interface and a 128 bit digital I/O module for CANrho.

The start-up, search for errors, and projecting on the AS-i circuit can all be made directly on the unit with the help of two switches, LCD display and LEDs just like with all the other masters from Bihl+Wiedemann GmbH.

Article no.	1174	1173
Rated operating current	Master power supply A approx. 200 mA from the AS-i circuit	Master power supply N approx. 70 mA from the AS-i circuit approx. 150 mA at 18 V DC from the power supply
Rated operating voltage	AS-i voltage 30 V DC	24 V DC (18 – 31.6 V DC)
Connections	CANrho: according to DeviceNet specification (5 pin Combicon plug) AS-i: according to specification	
Baud rates	125 KBaud, 250 KBaud, 500 KBaud, 1 MBaud	
AS-i cycle time	AS-i cycle time = 150 μs*(number of slaves +1)	
Displays		
LCD	AS-i slave address display, error indicators	
LED green (power)	Power supply OK	
LED green/red (MNS)	Modules / Power status	
LED red (config error)	Configuration error	
LED green (U ASI)	AS-i voltage OK	
LED green (ASI active)	AS-i operation normal	
LED green (prg enable)	Automatic slave programming possible	
LED yellow (prj mode)	Projecting modus active	
Buttons	2 (mode/set)	
Rated isolation voltage	≥ 500 V	
EMV	According to EN 50082, EN 50081	
Ambient temperature	0°C ... +55°C	
Storage temperature	-25°C ... +85°C	
Housing	Clamping rail case, LDG-A-30	
Dimensions (L, B, H)	75 mm, 100 mm, 110 mm	
Degree of protection according to DIN 40 050	Case IP40 Clamps IP20	
Weight	420 g	

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CAN/PROFIBUS Coupler

Bihl+Wiedemann

Automatisierungstechnik

**Connects a CANrho circuit
with a PROFIBUS circuit
via integrated interfaces**

**easy data exchange
between CANrho and PROFIBUS
via the internal coupler**

Article no. 1184   CANrho/PROFIBUS Coupler
Article no. 1188   CANopen/PROFIBUS Coupler

C E

The CERN/PROFIBUS coupler is the easiest solution for exchanging data between CERN and PROFIBUS.

It is often necessary with large applications to exchange data between the robot controller and another controller, for example to report operation conditions. In the past, this was commonly achieved with help from I/Os. The inputs were connected with the outputs of the other controller and vice versa. With help of the CAN-rho/PROFIBUS coupler the cost of wiring and of the components are reduced with this task. The CANrho/PROFIBUS coupler consists of a CANrho slave with 8 byte input data and 8 byte

output data and a PROFIBUS slave with 8 byte input data and 8 byte output data in a case. The slave outputs are each connected to inputs of the other slave (CANrho slave output byte 1 with PROFIBUS slave input byte 1).

CANrho and PROFIBUS are constructed galvanically separated.

The unit has a one digit display with seven segments.

As long as one of both slaves are not exchanging data, the second slave has the default value of 0 on its inputs.

Further CAN protocols e.g. CANopen, etc. can be received upon request.

Technical data

Article no..	1184
Connections	PROFIBUS: D-Sub 9 pin CANrho: 4 pin Combicon plug
PROFIBUS-Interface	According to DIN 19245 parts 1-3
Baud rates	9,6 KBaud to 12000 KBaud, automatic recognition
DP functions	Illustration of CANrho data as I/O process data in PROFIBUS Full diagnosis and configuration via DP master
CANrho Baud rates	125 KBaud, 250 KBaud, 500 KBaud, 1 MBaud
Display	1 digit 7 segment
Rated operating current	< 120 mA at 24V
Rated operating voltage	24 V DC
Rated isolation voltage	≥ 500 V DC
EMV	According to EN 50082, EN 50081
Ambient temperature	0°C ... +55°C
Storage temperature	-25°C ... +85°C
Case	Clamping rail case
Dimensions (L, W, D)	100 mm, 25 mm, 120 mm
Degree of protection according to DIN 40 050	Case IP20
Weight	120 g

CANrho/PROFIBUS Connection

CANrho/PROFIBUS Koppler

CANrho		PROFIBUS
CANrho	8 Byte A →	PROFIBUS 8 Byte E
	8 Byte E ←	8 Byte A

9.2 Alphabetical Index

Notes

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