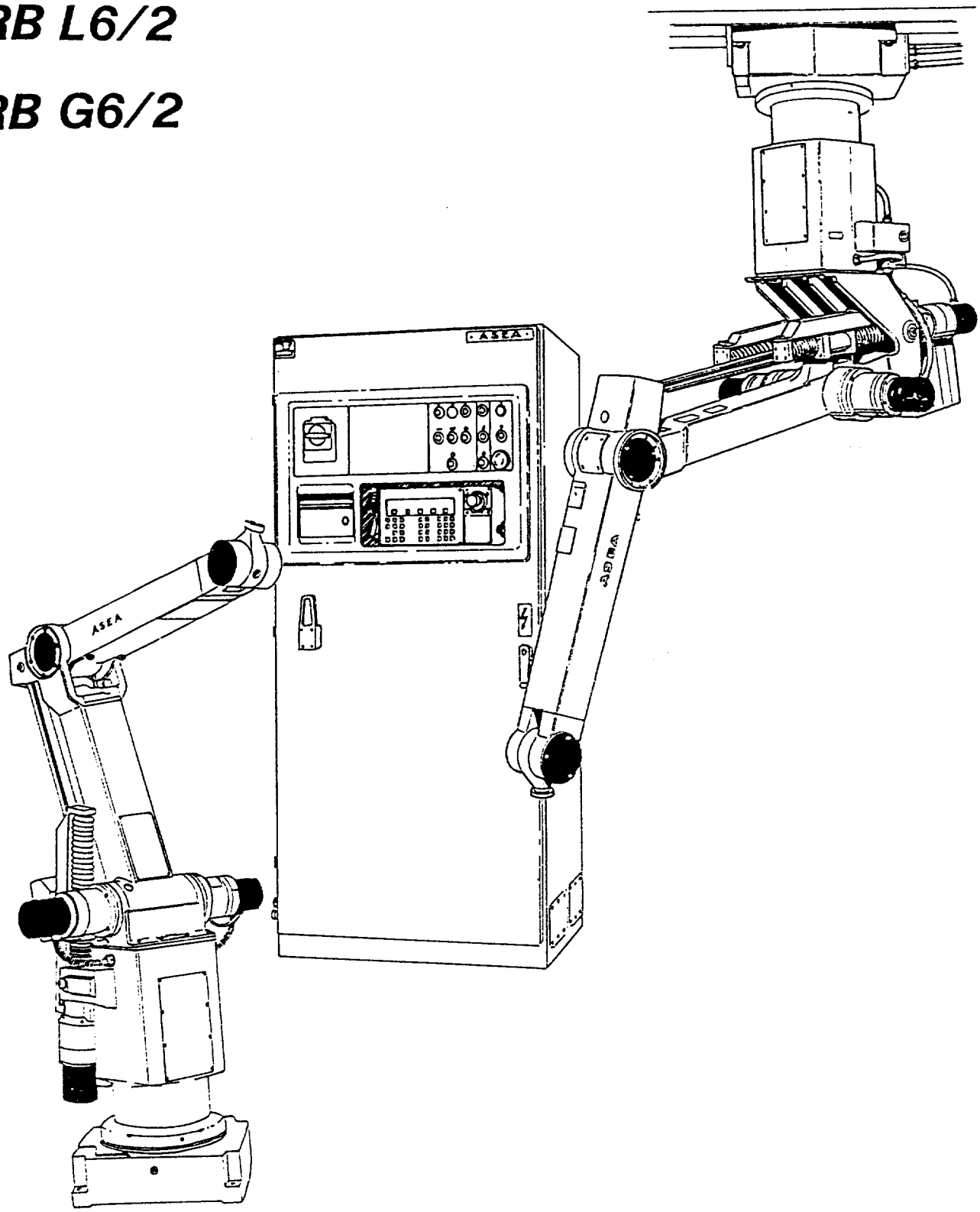
ASEA

INDUSTRIAL ROBOT SYSTEM

IRB L6/2

IRB G6/2



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CK 09-1101E SEPT 1986 DESCRIPTION

ASEA

Contents: Page

1 INTRODUCTION

The ASEA Industrial Robot System is a versatile aid in the automation of industrial manufacturing processes, and is particularly applicable in situations which are dangerous or difficult for the human operator. The system is designed to withstand severe conditions in the factory and workshop and may be used for serving groups of machines or as a processing robot. Examples of the latter application include arc welding, grinding, deburring, polishing, gluing, assembly, inspection, etc.

Robots used for arc welding and robots used for gluing are dealt with in descriptions of their own, which can be ordered from ASEA Robotics.

The robot system provides a wide range of control functions, which allow it to be used for specialized purposes, while keeping the cost of planning and peripheral equipment at a low level. The robot can also contribute to improved utilization of capital already invested in machines.

2
PRINCIPAL FEATURES

Separate electrical and mechanical sections

The ASEA Industrial Robot System is divided into two main units - the free-standing mechanical robot and the control equipment. This separation permits the location of the mechanical robot in limited working spaces. The control equipment can be placed separately, if this is demanded by space or environmental conditions.

Robust mechanical robot

The mechanical robot is compact and sturdy, the main structural components being of cast aluminium. All bearings are either roller or ball bearings. The result is a mechanical robot which is resistant to hard wear and designed to withstand severe industrial conditions.

The IRB L6/2 is intended to be mounted standing up. The IRB G6/2 is primarily intended to be mounted in an inverted position, but it can without modifications be floor-mounted.

Fully electric operations

The robot system is fully electric, with axes driven by DC motors, giving low maintenance costs, low noise level, low power consumption and high precision.

Modular design; Fault diagnosis

The control system is built up from modular units and includes advanced fault diagnosis facilities. This permits rapid fault tracing and simple replacement of defective components.

Dialogue programming

Programming is carried out by means of a digalogue between the operator and the control equipment, in a simple non-coded language using a portable programming unit. The use of the dialogue principle saves time and less documentation is required to operate the machine. The language used for communication via the programming unit is optional. Choose from English, German, French, Dutch, Italian, Spanish, Portugese, Japanese, Finnish or Swedish.

Defined work point (TCP)

The movements of the robot are programmed in such a way that a specific point, known as the work point or Tool Center Point (TCP), moves, relative to the robot, in a well defined manner. The TCP can be defined in any selected position, and the system can store nine different TCPs in its memory.

Joystick; Co-ordinate systems

A joystick on the programming unit is used to control movements of the TCP in rectangular or cylindrical robot-oriented co-ordinates, or in rectangular hand-oriented co-ordinates. This simplifies the work of programming and enables the robot to be moved quickly to the desired positions.

Program structure and subprograms

The program structure may contain a large number of separate subprograms. In these, the movements, conditions, patterns and "weaving" movements of the TCP of the robot can be defined and a refined and logical program structure built up.

Programs instructions; Editing functions

A wide range of program instructions and editing functions are available (see Chapter 5). These include:

- Movement between two points, at selected speed, programmed in mm/s and with an optional degree of accuracy. This provides opportunities for optimization of cycle times.
- Program control through inputs and outputs or from an internal register, providing jump, wait or interrupt in programs, or in the control of peripheral equipment.
- A programmed pattern of movement can be transposed in any desired direction, during both programming and execution. This feature is particularly useful if, for example, a fixture must be altered, or when a similar pattern of movements is needed several times during a process.
- A robot program can be corrected, erased, copied, renumbered, test-run, etc.

Inputs and outputs

There is wide flexibility in choice of digital or analog inputs and outputs:

In its standard form, the system is equipped with 7 digital outputs and 6 inputs intended for customer use. This can be extended to a maximum of approx. 140 digital inputs or outputs. Analog inputs and outputs can be used as well. The maximum number is 64 analog inputs or 16 outputs.

Floppy disk unit

The control system is prepared for the addition of a floppy disk unit of the plug-in type. This unit is used to store user programs on floppy disks and for mass storage and recall of programs during operation of the robot.

Program print-out

A printer can be connected to the robot system for print-out of the program on paper, an alphanumeric keyboard for entry of commentarys in the program or a printing terminal for both of these purposes as above.

Computer link

The robot system can be equipped with a computer link for communication with a superior computer.

Adaptive control

Sensors can be connected to the robot, for adaptive control. Possible functions include searching, contour following and speed control. Both digital and analog sensors can be used.

External axes

The robot system can have up to nine synchronous servo-controlled axes. This means that external functions in the peripheral equipment such as fixtures can also be servo-controlled in addition to the axes of the robot itself.

Third wrist motion

The robot system can be equipped with a third wrist motion, to increase the flexibility of the robot (see item 30 on specification form).

Emergency stop with self-supervision

The emergency stop circuits in the robot system are self-supervisory. This means that an emergency stop follows the occurrence of a fault in the circuits concerned.

Seam Finder

A Seam Finder can be added to the system. It is primarily intended for locating welding seams during arc welding applications, but it can also be used whenever performing tasks relative to objects, which exact position may vary. Examples of this are palletising and picking from conveyors.

Automatic restart

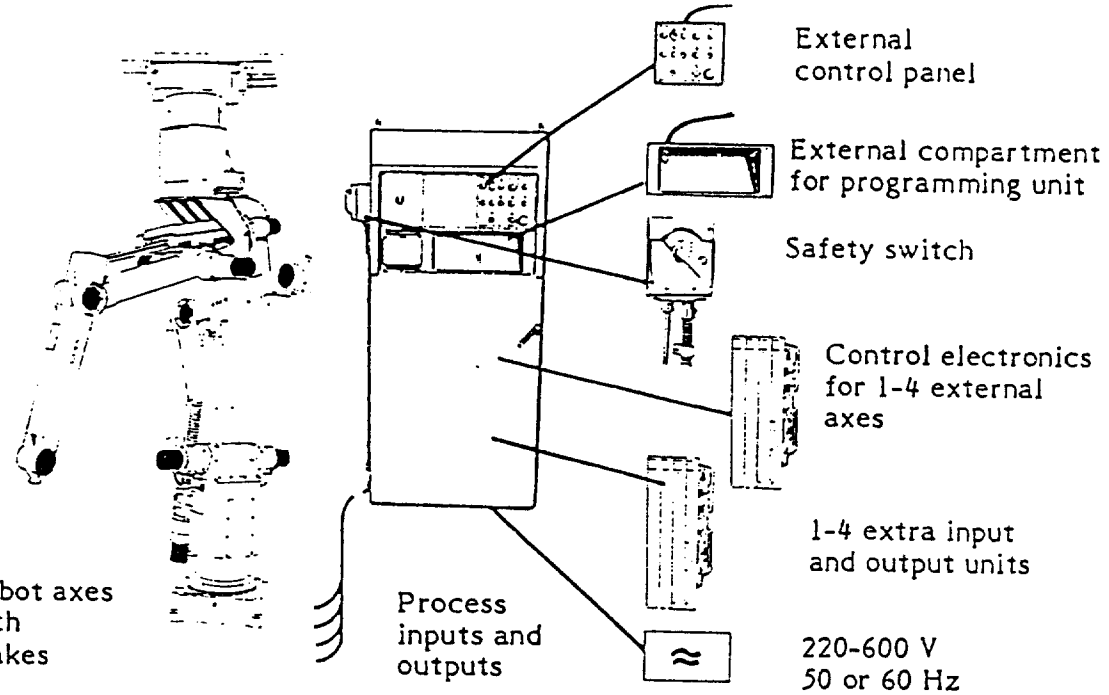
The robot system can be equipped with an absolute measurement system for all robot axes. This enables automatic restart without synchronization after any emergency stops.

3
SYSTEM STRUCTURE

The Industrial Robot System consits of a basic version and a variety of optional accessories, see below. The basic version, the mechanical robot together with a control cabinet, can be supplied in a number of variants.

Variants of mechanical unit

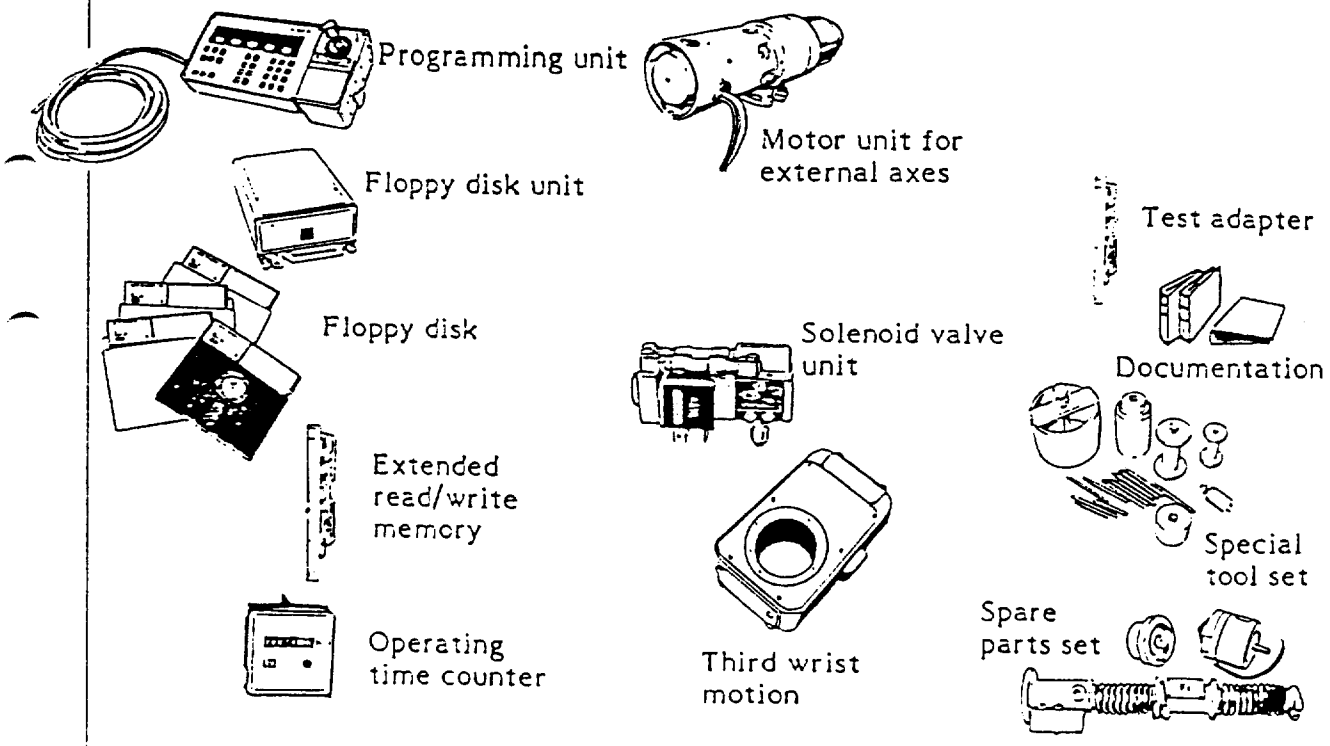
Variants of control cabinet



Accessories to control equipment

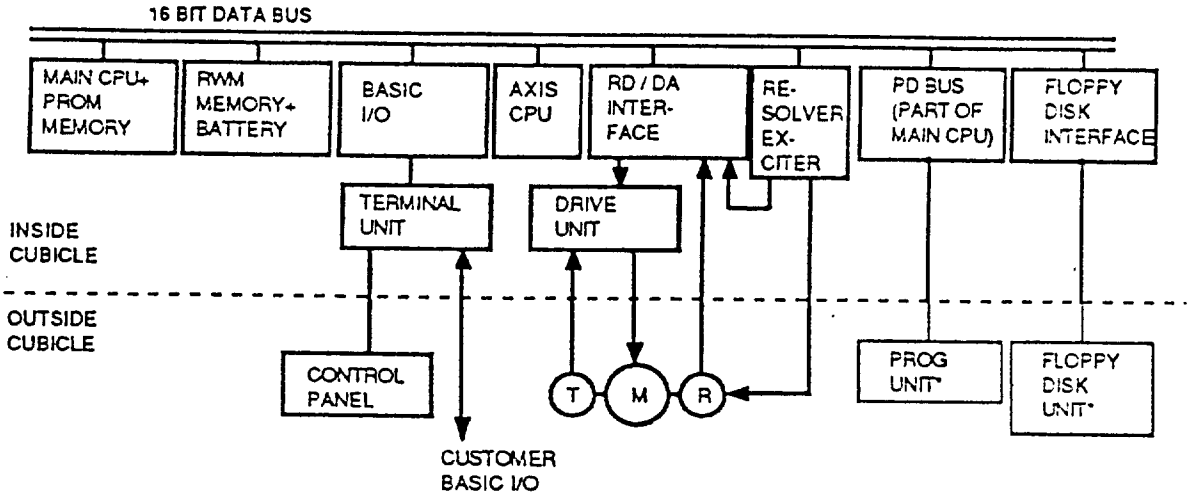
Mechanical unit

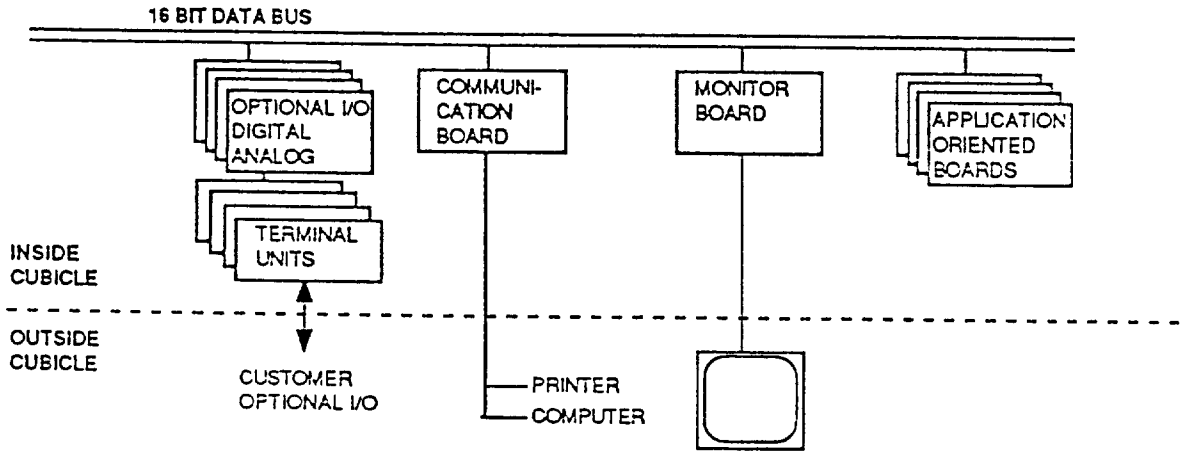
Field servicing



3.1
Control cabinet

——— = STANDARD
——— = OPTIONAL
* = MOVABLE BETWEEN ROBOT SYSTEMS
- - - - = CUBICLE WALL





The control cabinet contains the electronics and the drive equipment required to control the mechanical robot and the peripheral equipment. The robot is linked to the control cabinet by means of a cable, which may be up to 15 m in length.

Communication between the operator and the control system takes place through the control panel and the programming unit.

The control system communicates with the peripheral equipment through input/output units of different types depending on the needs of the particular installation. The status of the inputs and outputs (I/O) is indicated by LEDs on the front of the I/O-units.

The control program for the robot is stored in the permanent memory of the control system (EPROM), while the user program is stored in the read/write memory (RWM), which is provided with battery back-up to protect the contents in case of power failure. The capacity of the user memory can be easily increased with additional memory boards, or by the use of a floppy disk unit for mass storage.

The electronic units in the control system are connected to a common data bus through which all information is passed between units, and through which the system is monitored by the main computer.

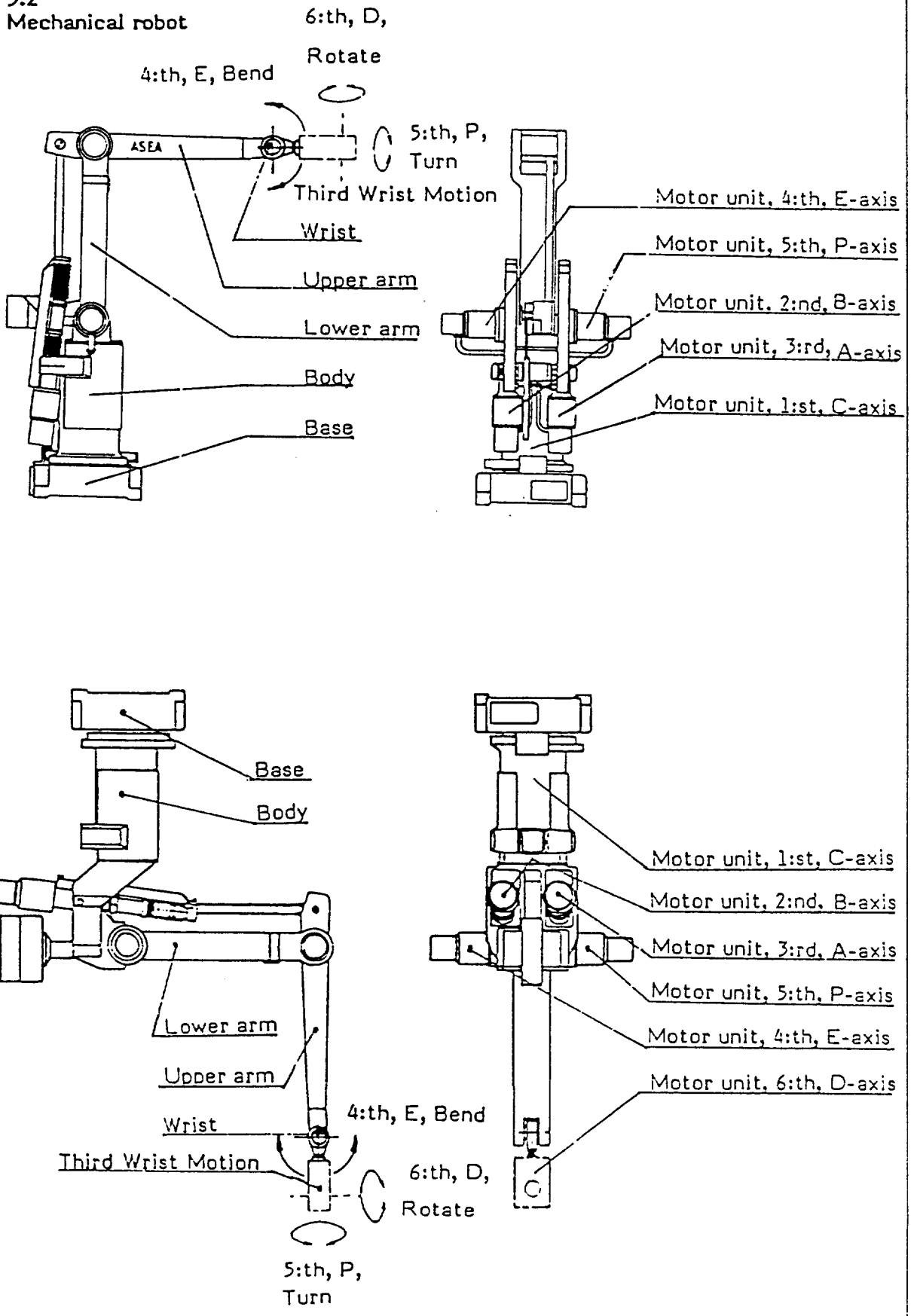
The servo system is served by its own computer; this contributes to the good performance of the system.

The control system carries out continuous tests on the most important functions of the robot system, and more extensive tests are performed after start-up. If a fault is detected, program execution is immediately interrupted, the FAULT lamp illuminates and a message showing the type of fault is displayed in plain language on the programming unit.

To assist in fault tracing, the various units of the control system are fitted with test points and LEDs which indicate the status of the input and output signals of the system, the servo system and the interlocking chains. LEDs are provided to indicate the supply voltages to the electronic units and to indicate the communication of the electronics unit with the central unit.

Separate test equipment is also available in the form of a test adapter.

3.2
Mechanical robot



The arm movements are made by means of ball screws which actuate the arms through levers. The lower arm of the IRB L6/2 is balanced with a spring unit. The wrist axes, 4:th (E) and 5:th (P) axes, are driven by link rod systems inside the lower and upper arms. The wrist is so designed that the bending movement (4:th (E) axis) is always in the plane of the arm.

The motor units and mechanical transmissions for all robot axes, except for the 1:st (C) axis which is mounted inside the body, are located on the outside of the rotating body of the robot.

The motor units consist of a DC motor, a tachometer for speed control and a resolver for indication of position. As an option, brakes for either two, four or five axes can be fitted for increased performance. Brakes on the 2:nd (B) and 3:rd (A) axes are standard on the IRB G6.

The transmissions are of two types; gearboxes of "Harmonic Drive" type and ball screws.

The servo amplifiers are located in the control cabinet, adjacent to the other electronic equipment.

The cables to user connections are routed through the arm sections to the wrist. Connections are made through the underside of the forward end of the upper arm.

A solenoid valve can be fitted in the upper arm for control of pneumatic outlets.

4
OPERATION AND PROGRAMMING

4.1
Controls

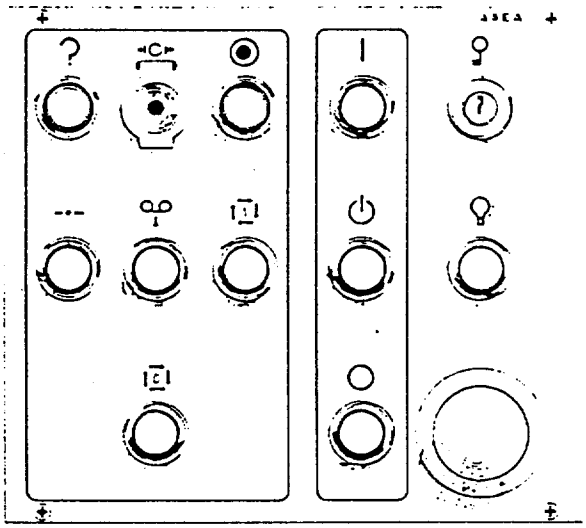


Figure 4-1 Control panel

The **control panel** carries the controls and switches needed for starting up the system, loading and storage of programs from floppy disks, start/stop of the robot and actuation and reset of the emergency stop system.

Indicator lamps on the panel show the current status of the system. The indicator lamps on the control panel and programming unit can be checked by means of a test button. It is possible to lock the programming unit to prevent access to the robot program by unauthorized persons.

The control panel is also protected from mechanical damage by a foam rubber padding around the panel.

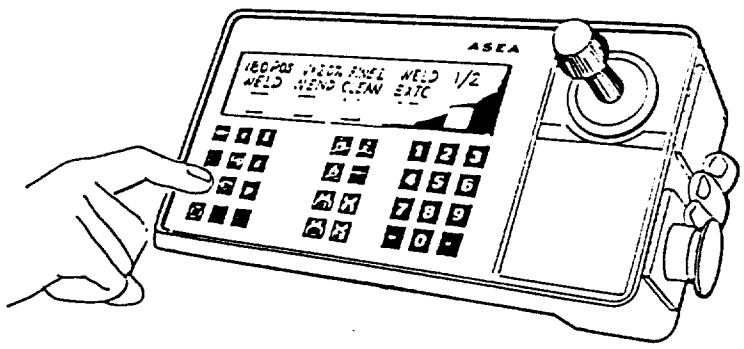


Figure 4-2 Programming unit

The **programming unit** provides all the functions required for programming and operating the robot and external axes. The programming procedure is based on the principle of "self-instructing operator communication". The programming unit is, for this purpose, provided with a text display consisting of two lines, each of 40 characters. This display provides the operator with guidance during the whole of the programming procedure. Five multi-function buttons, located under the display window, considerably simplify programming and reduce the number of buttons required.

The multi-function buttons are given different functions according to the main type of instruction selected by the operator. The system then asks for additional information, until the complete instruction has been fully defined. The current instruction is shown in plain language on the display.

The robot is operated manually by means of a joystick which has three degrees of freedom of movement. A selector switch governs the effect of movement of the joystick, viz. movement of the TCP from one position to another, rotation round the TCP and movement of an external axis.

The joystick is activated only when the safety plate situated below the joystick is depressed. This prevents the robot moving as a result of unintentional movement of the joystick.

The programming unit has an integral test program for the display, keys and joystick.

The programming unit is ergonometrically designed and can be adjusted to suit either right-handed or left-handed users.

4.2 Safety features

The robot system has a number of built-in safety features. Some of these are:

- Emergency stop, which can be activated from the programming unit, from the control panel, or from an external emergency stop device, as well as automatic triggering caused by motor overcurrent. The emergency stop circuits are self-supervisory, i.e. an emergency stop is caused by the occurrence of any malfunction in the circuits concerned.

- The IRB G6/2 is normally equipped with brakes on the 2:nd (B) and 3:rd (A) axes, and the IRB L6/2 is normally delivered without brakes, but options are given. Both robot models can be ordered with brakes on:

  - o 2:nd (B) and 3:rd (A) axes.
  - o All axes but 1:st (C) and 6:th (D).
  - o All axes but 6:th (D).

  Robots can also be delivered without any brakes, but this is normally not recommended.

- Work stop gives the possibility to stop the robot system, thus allowing entry of the hazardous area with retained personnel safety for service etc.

- A program cannot be started from the control panel and synchronization cannot be performed when the programming unit is connected and has been removed from its compartment.

- The maximum speed of the robot is limited to 25 % of the maximum speed, and the emergency stop is activated if the robot should exceed 40 % of its maximum speed, when the programming unit is connected and has been removed from its compartment.

- An alarm is given, through a fault output if the maximum waiting time is exceeded, when the instruction "conditional wait" (with time monitoring) is given.

- Immediate program stop controlled by a direct input signal.

- Safety plate at the joystick, which works as a dead man's handle for the robot movements when work with the programming unit in the hazardous area is performed.

- Resolver monitoring, which initiates an immediate emergency stop if a resolver signal is not received, or represents an anomalous value. This prevents the possibility of uncontrolled running of the robot.

- When a programming unit is not connected, it must be replaced with a dummy contact. If neither of these is connected, an emergency stop is triggered.

N.B. Not all are included in the basic system, see specification form.

4.3 Programming

Programming of a given pattern of movement is performed by the operator who moves the robot, or the external axis, to the desired position in the selected co-ordinate system by use of the joystick. Each of these positions is registered in the program through the programming unit. The robot can be moved with a high degree of accuracy by manual operation, one increment at a time, to any chosen position in the selected co-ordinate system.

When the program is executed, the movements are carried out in either straight-line or robot co-ordinates.

Instructions for program control, call-up of programs, program adjustment and other instructions which are independent of the position of the robot, can be entered into the program at any time. Complete program blocks are stored, either in the memory of the control system, ready for immediate use, or on a floppy disk for use on a later occasion. Part or the whole of the program can be returned to the user memory when required. One or more program blocks can be stored on a floppy disk.

A program block is built up from a main program and an optional number of subprograms. An individual program step consists of an instruction and instruction number, either with or without additional information which is known as an "argument".

Example of program:

10 V = 500 MM/S MAX = 1000 MM/S	Basic speed and max. speed for coming program section.
15 TCP 1	TCP for coming program sequence.
16 RECT COORD	Calls for movements in rectangular co-ordinates (straight-line running) in coming program sequence.
20 POS V = 100	Position at 100 % of basic speed.
30 WAIT TIME 3.5 S	Wait for 3.5 s. Then proceed with next instruction.
40 POS V = 50 FINE	Position at fine point, small zero-zone, at 50 % of basic speed.
50 CALL PROG 7	Call-up subprogram 7.
60 SET OUT 5	Set output 5.
70 RETURN	End of program and return to 10.

One instruction at a time is shown on the display of the programming unit, as in the example above; this applies both to actual programming and checking of programs.

Editing and correction can be carried out on a complete program, part of a program or an instruction.

A program can be test-run without movement of the robot or activation of any of the outputs. The conditions stated in logic instructions can be simulated.

Program operation is possible either continuously or manually, one instruction at a time, either forward or backwards (positioning instructions only). The speed is selected, for each positioning instruction, as a percentage (0.1-800 %) of the basic speed stored in the program. This speed percentage can be adjusted, for the complete program block (0-400 %), in steps of 5 %, even during operation.

For a description of the instructions and functions included in the system, see Chapter 5, Technical Specification.

5
TECHNICAL SPECIFICATION

5.1
General

The ASEA Robot System is fully electric, computer-controlled and programmable, and has up to nine servo-controlled axes.

The industrial robot system consists of a basic system and various accessories. A basic version is supplied as standard, and additional functions are obtainable in variants of the basic system, and by the addition of accessories. These are selected on the "Specification form".

5.2
Basic version

5.2.1
Design

The robot consists of two free-standing units, the mechanical robot and the control cabinet, linked by a cable.

Control cabinet (see section 5.5), contains all the electronic components of the robot system, together with the electrical drive equipment needed to control the robot. The control cabinet is cooled by internal air circulation; a thermal sensor monitors the temperature in the cabinet.

The control panel is located on the control cabinet, together with compartments with plug-in connections, for a programming unit and a floppy disk unit. Electrical connections, including power supply, signals to robot, process signals and signals to peripheral equipment, are located at the lower left side of the cabinet or, as an option, right side.

Mechanical robot (see section 5.5). The main structural components of the robot are of cast aluminium. All bearings are of the rolling type. Mechanical transmissions are gearboxes of Harmonic Drive type or ball screws. Resolvers or tachometers are used for position indication and speed control. The axes are powered by servo-controlled DC motors. The electrical connections are made to the rear of the base of the robot.

5.2.2
Functions

The mechanical robot is controlled and monitored from the control cabinet; the movements of the robot are described in section 5.5. Programming and manual operation are performed with a programming unit (accessory). The program is stored in the memory of the control system, or on floppy disks by means of a floppy disk unit (accessory).

The following principal functions are provided in the basic version:

- **Co-ordinate systems** for definition of the movements of the robot.

  Manual operation
  - o Rectangular co-ordinate system.
  - o Cylindrical co-ordinate system.
  - o Hand-oriented, rectangular co-ordinate system.

  Continuous operation
  - o Rectangular co-ordinate system.
  - o Robot co-ordinate system.

  For robots with 6 axes there is also:
  - o A rectangular co-ordinate system with compensation of the wrist position when running past so-called singular points.

- **Synchronization** of the robot system need normally only be carried out when the voltage is first switched on. When synchronization is needed, this is indicated by the flashing sync. pushbutton on the control panel. It can be carried out irrespective of the initial position of the robot at the start of synchronization, and need normally not be repeated after an emergency stop.

- **Function parameters** are provided for definition of certain functions in the system. The parameters are programmable and are stored in a memory with battery back-up. These parameters are normally decided at the time of installation of the system and can be stored on a floppy disk. The parameters assume standard values if not otherwise defined.

  TCP and FRAME values are also processed as system parameters and can be stored on a floppy disk together with these.

  The following parameters may be established:

  - Access level for the programming unit, i.e. the degree of access to all or some of the programming functions, controlled by a lock on the control panel.
  - Synchronization positions; choice of three different positions around the 1:st (C) axis.
  - Number, operational range and servo data of the external axes.
  - Maximum time for limited conditional WAIT, up to 320 s.
  - Type and number of I/O-units.
  - Memory size.

- Three different zero zones for accurate positioning and one zero zone for coarse positioning.

- Metric or US units for displaying and entering values for speeds and distances.

- Limitations of the working range of robot axes.

- Mounting of optional third wrist motion.

o **Instructions** (see also additional instructions in section 5.3)

- Movement between two points, at optional constant speed in mm/s and three optional degrees of accuracy of positioning. Can be programmed in straight-line or robot co-ordinates.

- TCP can be programmed for nine different positions, relative to the centre of the turning disc. TCP locations are defined with a special program function by means of manual running of the robot.

- Co-ordinate transformation by means of programmed reference points; the subsequent part of the program is carried out relative to the actual position (not relative to its actual orientation) when the reference point instruction is executed.

- Weaving movement; defined in a subprogram and superimposed on a straight-line positioning.

- Program control of, or by, peripheral equipment, through inputs and outputs, or with the assistance of an internal register. Outputs can be set at "0" or "1" and can be inverted and pulsed. Positive and negative numbers can be entered in the register.

- Logical instructions:

  * Jumps can be made, conditionally or unconditionally, to optional instruction addresses within a program.

  * Wait in a program sequence can be generated conditionally or unconditionally. The conditional wait time can be limited to a maximum (see Function parameters). Unconditional wait can be generated from 0 to 100 s.

  * Instructions can be interrupted for immediate execution of the next subprogram or one of five subprograms, depending on which direct digital signal input is activated. (See section 5.3, Digital input/output capacity.)

- Pattern handling (e.g. picking and placing of parts. Each pattern is programmed in the form of an individual subprogram and is treated independently of the others.
- Call-up of subprograms linked in ten levels. The subprogram called can be repeated up to 99 times.
- Reading of optional program blocks from floppy disks during continuous operation (mass storage facility). An optional number of subprograms in the user memory can be erased at the same time.
- Position register for program controlled storage of the position of a point. A displacement in any desired direction can be added to the stored position.
- Control of gripper.

o **Editing functions**

- Erasing and editing of a complete program or part of a program or instruction.
- Copying of a program, to a different program number.
- Re-numbering of instructions in a program to even tens.
- Alteration of position, with or without movement of the robot, even while a program is being run (max. 10 mm).
- Test-running of program, with or without movement of the robot.
- Simulation of conditions in logic instructions.
- Listing via the display of program numbers used.

5.2.3
Technical data

	Number of servo-driven degrees of freedom			5 (6)*
Performance	Type of movement	Axis	Working range	Max. speed
	Rotational movement	1:st (C)		
	IRB L6/2		360°	114°/s
	IRB G6/2		360°	114°/s
	Radial arm movement	2:nd (B)		
	IRB L6/2			1.3 m/s
	IRB G6/2			1.1 m/s
	Vertical arm movement	3:rd (A)		
	IRB L6/2			1.3 m/s
	IRB G6/2			1.1 m/s
	Tilting wrist movement	4:th (E)	± 90°	138°/s
	Turning wrist movement	5:th (P)	± 180°	234°/s
	* Third wrist movement	6:th (D)	± 340°	240°/s

Handling capacity

See Chapter 6 for diagram which for different loading cases specifies the maximum distance of the centre of gravity of the load from the support.

Incremental movement	Approx. 0.1 mm
Repetition accuracy at wrist center	< ± 0.2 mm
Maximum moment of inertia	0.24 kgm^2 5 • 10^{-2} kgm^2 *
Maximum static load	12 Nm 6 Nm *
Power consumption	
Operation	0.6 - 2.0 kW
Stand-by	Approx. 0.5 kW

Environmental factors

Enclosure class	IP 54 (IEC)
Environmental temperature	
Control equipment, operation	+5 - +45 °C
Mechanical robot and motors	+5 - +50 °C
Upper arm and wrist	+5 - +80 °C
Relative humidity	Max. 90 %

* When equipped with Third Wrist Motion.

Physical data	**Weight**		
	Mechanical robot		
		IRB L6/2	145 kg
		IRB G6/2	170 kg
	Control cabinet		350 kg
	Dimensions		
	Mechanical robot H x B x D		
		IRB L6/2	1325 x 728 x 965 mm
	(transport position)	IRB G6/2	1400 x 740 x 1100 mm
	Control cabinet		1900 x 820 x 700 mm
Electrical connections			
	Mains connection		
	Main voltage		3 phase, 380 V
	(Other voltages are available as options, see specific. form.)		+10 %, -15 %
	Frequency		50 Hz ± 1 Hz
	Voltage supply		
	Available for optional connection		Nom. 24 V DC, max 2 A
	Digital connections (Can be galvanically isolated from the robot system.)		
	Inputs		4 Rated voltage 24 V DC Impedance 3.5 kohm
	Outputs		4 (+ 2 for gripper) Current-sourcing Rated voltage 24 V DC Load capacity 150 mA
	Signal connections		
	Input signals		- Opening contact to give emergency stop. Supply 24 V - Opening relay contact to give emergency stop (externally supplied relay coil). Supply 24 V.
	Output signals		- Contact open when emergency stop activated - Closing contact when emergency stop activated Load capacity 60 V/1 A. - Contact closed when front door is open. Supply 220 V/270 mA - Contact closed in "operation" mode. Supply 220 V/135 mA.

Program capacity

Number of programs in user memory	
Main program	1
Subprograms (number definable)	≤ 9 999
Memory	
Capacity	Approx. 8 kword
Number of positioning only instructions (Estimated with 50 % POS-instructions and 50 % other instructions.)	Approx. 860
Battery back-up	Typical 1500 h
Re-charging time	Approx. 24 hours
External memory back-up	Nom. 24 V DC, 10 mA
TCP	
Number definable	9
Definition range	0-575 mm
Position register	
Number definable	100
Register	
Number definable (may contain five-digit numbers with sign ± 32 000)	100 *)
Sensors, connection possibilities (Requires adaptive control program, see Variants of the basic version.)	
Number addressable	16
The sensors can be of digital type with up to 7 bits + sign bit, or of analog type. Connections are made to the digital or analog inputs of the system. (See Variants of the basic version.)	

*) Robots equipped with Vision can define 120 registers.

5.3
Variants of the basic version

Control electronics for external axes (1)

The robot system can be extended by the addition of control electronics for the connection of up to four external axes, which operate synchronously with the axes of the robot itself.

It is recommended that, if possible, the motor assembly supplied by ASEA be used (see Accessories). If other motors are to be connected, ASEA should be consulted.

Cable length, mechanical robot - control cabinet (2)

The length of cable in the basic model is 6 m, but alternative lengths of 10 m or 15 m can be supplied.

Separate location of control panel and compartment for programming unit (3, 4)

The control panel and/or the compartment for the programming unit can be supplied for external mounting with a cable connection to the control cabinet (see dimensioned drawing, section 5.5). Lengths of cable may be 6 m, 10 m or 15 m.

Cable connections to control cabinet (5)

In standard form, the cables from the mechanical robot to the control cabinet are connected at the left side of the cabinet, but connection at the right side can be supplied as an option.

Safety circuit breaker (6)

The mains supply to the control cabinet can be fitted with a safety circuit breaker, located on the outside at the left of the cabinet.

Mains voltage (7)

In addition to the 380 V, 3-phase supply, the robot system can be adapted for the following 3-phase supplies: 415 V, 440 V and 475 V, or 500 V, 525 V and 600 V or 220 V.

Mains frequency/fuses (8)

In addition to the standard form suitable for 50 Hz, the robot system can also be supplied for 60 Hz mains supply, and with different fuses for different countries and markets.

50 Hz/D-type	Standard
60 Hz/US-type	Standard in USA and Japan
50 Hz/Red-spot type	Standard in England

Digital input/output capacity (10, 11, 12)

The I/O units of the basic version can be supplemented with extra input or output units, as described below.

- When extra digital input or output units are delivered, a number of inputs and outputs are reserved for fixed signal functions as follows:

  A. If one or more extra digital input units are delivered, there are 9 direct-action inputs.

Direct signal input:

1	= Interrupt instruction
2	= Interrupt program
3-7	= Jump to program 1, 2, 3, 4 or 5
8	= Program start
9	= Program stop

  B. If one or more extra digital output units are delivered, there are 7 status outputs.

Status signal outputs:

1	= Operation
2	= Cycle on
3	= Fault
4	= Programming unit removed
5	= Gripper device 1, on/off
6	= Gripper device 2, on/off
7	= Stop search

N.B. There are two main types of digital I/O-boards, 110 for 24 V DC-signals and 130/131 for AC- or DC-signals with higher voltages, as specified below. When both types are required in a robot system the specification form prints (12) and (13) allow a choice of which type of I/O-boards that is to contain the fixed signal functions.

- All extra inputs and outputs (but not the basic version inputs and outputs) are galvanically isolated from the robot system, if external power supply is used.

  If internal power supply is desired, this can be obtained from the 24 V DC, 2 A supply available in the control cabinet. The inputs/outputs which are supplied internally are not, however, galvanically isolated from the robot system.

- The following input and output units may be selected, up to a total of four (including analog units, see analog input capacity).

* Input/output unit, Type DSDX 110

  Inputs: 16, opto-coupled
  Rated voltage 24 V DC
  Input impedance 3.5 kohm

  Outputs: 16, opto-coupled
  current-sourcing transistor amplifier
  Rated voltage 24 V DC
  Load capacity 150 mA

* Output unit, Type DSDO 110

  32 outputs, opto-coupled
  current-sourcing transistor amplifier
  Rated voltage 24-48 V DC
  Load capacity 150 mA

* Output unit, Type DSDO 131

  16 outputs, with transistor-activated output relays
  Rated voltage 24-240 V DC/AC
  Load capacity 3 A
  Break power (AC) 720 VA, (DC) 44 W

* Input unit, Type DSDI 110

  32 inputs, opto-coupled
  Rated voltage 24 V DC
  Input impedance 3.5 kohm

* Input unit, Type DSDI 130

  16 inputs, opto-coupled
  Rated voltage 110 V DC/AC
  Input impedance 18 kohm

Analog input capacity

The control system can be fitted with a 16-channel analog input unit, type DSAI 120.

Input signal 0 - $\pm$ 10 V Resolution 10 mV

Analog output capacity

The control system can be provided with a 4-channel analog output unit of DSAO 110 type. The channels are galvanically isolated from the robot system. Each channel can be adapted to the following current and voltage ranges by means of movable jumpers.

0 - $\pm$ 20 mA, resolution 10 µA ($R < 450$ ohms)
0 - $\pm$ 10 V, resolution 5 mV ($R \geq 500$ ohms)

Dead man's handle (14)

A dead man's handle function is provided by the safety pad on the programming unit when the programming unit is withdrawn from its compartment.

The robot system is switched from the STANDBY mode to the RUN mode when the safety pad is depressed, operating a contact switch, and returns to STANDBY by means of hardware control when the safety pad is released.

When the work stop function STANDBY signal is activated with the programming unit disconnected, the robot goes to STANDBY.

When the work stop STANDBY signal is activated with the programming unit connected, the robot goes to STANDBY if the safety pad is not depressed. If the STANDBY signal is then deactivated, the robot system remains at STANDBY.

When the work stop STANDBY signal is activated with the programming unit connected and the safety pad depressed, the signal has no effect but if the safety pad is then released while the STANDBY signal remains active, the system goes to STANDBY and remains at STANDBY when the signal is de-activated.

A return to the RUN mode can be obtained with the work stop RUN signal.

The program can be restarted via the Program Start input.

Brake on robot axis (16)

The robot system can be provided with holding brakes on a number of robot axles. When a brake is installed on an axis, this axis remains in its position when the voltage disappears from its motor. This avoids the risk of a tool or work piece lodging in a position in which it can cause damage.

The IRB G6/2 is normally equipped with brakes on the 2:nd (B) and 3:rd (A) axes, and the IRB L6/2 is normally delivered without brakes, but options are given. Both robot models can be ordered with brakes on:

- 2:nd (B) and 3:rd (A) axes.
- All axes but 1:st (C) and 6:th (D).
- All axes but 6:th (D).

Robots can also be delivered without any brakes, but this is normally not recommended.

N.B. If the robot system is delivered with the dead man's handle option, the maximum holding brake alternative must also be provided, see (14).

Documentation (17)

Documentation supplied with the robot includes:

- Programming Manual (540)
- Product Manual (545)

  The Product Manual contains:

  - o Descriptions
  - o Installation manuals
  - o Maintenance manuals
  - o Circuit diagrams
  - o Spare part lists
  - o Descriptions of accessories and add-on kits

Programming Language (21)

The robot system is available in different versions with the text presented on the programming unit display in different groups of languages. The following groups are available:

- English, German, French and Dutch
- English, Italian, Spanish and Portugese
- English, Japanese, Finnish and Swedish

Local requirements (22)

For adaption to local requirements the control cabinet can be provided with:

- Protective screens in front of all fans
- Plastic spiral protection around all loose cables between racks and door
- Extra protection against touch of live parts of contactors in the power unit

Additional functions (23)

Program print-out (23.2.1)

In addition to the functions made available by the standard program it is additionally possible to connect:

- A printer for program print-out on paper.
- An alphanumeric keyboard for entry of comments into the program with, or without, program stops connected to them.
- A printing terminal combining both of the preceding functions.

For easy connection of either of the units mentioned above there is, on the right side of the cabinet:

- A 220 V outlet
- A 25-pole socket connector for signal transmission to and from the robot system.

In addition to this an adapter lead is delivered, which is provided with a pin connector fitting the signal outlet. In the other end there is a 25-pole "D"-connector (socket).

N.B. The software is only included in the additional program functions (24).

Remote control (23.2.2)

The ASEA remote control system is very suitable when a customer requires several robots to be controlled from an existing central control system.

The signals from the central control unit are transmitted to the robot system via a relay unit which permits remote control of the control panel functions.

The relay unit is galvanically isolated, which means that the operating voltage used is not the same as that for the internal control equipment of the robot.

Monitor (23.2.3)

The monitor displays a number of instructions in the active program when the robot is not executing a program. This gives a good survey over the current program during programming and editing work.

If "Additional functions" are provided, the monitor will display the last executed eventual commentary in the program during program execution. This makes it easier for the operator to follow what is going on.

Automatic restart (23.2.5)

(Only for IRB L6 and G6 with 5 axes)

The robot system is delivered with more than one resolver - position transducer - for each robot axes (three resolvers on axes 1, 4 and 5 and two resolvers on axes 2 and 3) and a slightly different servo system. This system structure gives the operator access to the following functions:

- During start-up of the system, the robot is not to be synchronized. The two resolvers for each robot axis provides information to the control system about the position of the robot system - everywhere within the working area.
- When a sudden failure of the main power occurs during program execution, the control system will store the current position of the robot - with the help of a battery back-up. When the operator in a later stage is to start program execution again the following alterantives are available:
  - o Automatic restart - without a previous jogging or synchronization of the robot. It is possible to correct the status for digital inputs/outputs - or the values in number registers - before an automatic restart. It is also possible to connect an external control device - or a computer - which can order restart for an entire group of robots.
  - o Ordinary restart - from the first instruction in the main program. It is possible to correct the status for digital inputs/outputs - or the values in number registers - before an ordinary restart.

The restart function can be enabled - or disabled - with the help of a function parameter.

The resolvers and the motors are connected to the servo system according to the following figure (compare with the basic system in "3.1, Control cabinet").

Cables, upper arm (23.2.50)

If required, leads for user-adapted connections can be routed via the arm system to the wrist. This is necessary if:

- Sensors for adaptive control are to be installed on the robot (24).
- One or two solenoid valves are to be installed on the robot (315).

The leads are connected on the underside of the forward end of the upper arm.

Additional program functions (24)

In addition to the standard program with the functions and properties described above, the following options are available:

Added functions (24.2)

The following functions are additional to those made available by the standard program:

- Circular interpolation defined as three points on a circular arc in space. For circular areas approaching 360 degrees or greater, five points are required.
- Co-ordinate transformation by moving the origin of the co-ordinate system in a straight line and rotation of the system around any axis in the basic co-ordinate system. Up to five different co-ordinate transformations can be programmed. Optional transformations can be called at any point in the program.

  If the robot system is provided with "Adaptive control", automatic definition of the transformation can be performed during program execution, by means of sensor controlled searching.
- Programming of temporary connections between a numerical register and inputs/outputs (ports) of both analog and digital type. Numerical values can be transmitted between number registers and inputs and outputs for program control and control of peripheral equipment.

Adaptive control (24.3)

(including the functions under "Added functions")

The following functions are provided in addition to those offered by the standard program:

- Searching with up to three sensors. The search stop can be delayed by 0.5 s. Searching is carried out as:

* Linear search between two points.

* Directional search commenced by linear scanning followed by free search (max. 5 cm), in accordance with pre-programmed correction movements.

- Control of speed (by one sensor) of programmed movement. Time lag is automatically compensated for, if the required speed change is more than 25 % of the programmed speed within 50 ms.

- Contour following, in accordance with pre-programmed correction movements. Up to three sensors can be used simultaneously.

- Up to 16 sensors can be addressed. Sensors may be of digital type, with up to 7 bits + 1 sign bit, or they may be of the analog type. Connections are made to the digital or analog input of the robot system (see Variants of the basic version).

N.B. If sensors are to be mounted on the robot, the leads for user connections must be connected to the wrist via the arm system (19).

Computer link (24.4)

(including the functions under "Added functions and "Adaptive control")

In addition to the functions offered by the standard program, this permits asynchronous communication between the robot system and a supervisory computer. This permits:

- An external computer to be used as a program bank.

- An external computer to automatically control program entry and storage, and to control and monitor program execution.

- An external computer to directly control the movements of the robot.

Additional equipment (25)

Inspection window (25.2.1)

The door of the control cabinet can be provided with a vision panel 485 x 1000 mm.

Advantages with an inspection window are:

- Total view of the control board signal system.

- The door can be closed and locked.

Door interlocking (25.2.2)

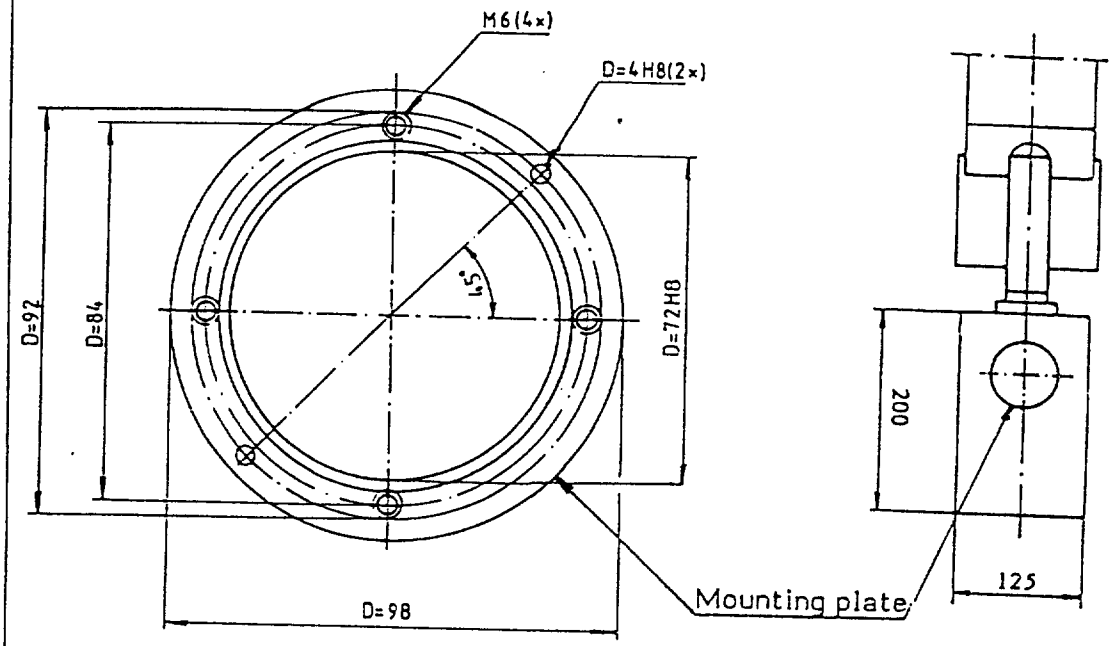
The control cabinet can be fitted with a door interlocking to ensure that the door remains locked, while power supply to the system is switched on.

Earth-fault protection (25.2.3)

If required, earth-fault protection can be supplied, to indicate earthing faults in the motor cables and as protection for the drive units.

Third wrist motion (30)

A third wrist motion is installed as shown in the figure below.



After delivery, the installation can be changed in accordance with one of the following alternative (see fig.). The necessary equipment for this is supplied in a separate installation package. TCP-information can be adapted to the installation concerned by means of a function parameter.

Note that the handling capacity of the robot decreases in accordance with the following loading diagram and technical data:

Max. moment of inertia:	0.05 kgm^2
Max. static load:	6 Nm

The third wrist motion can be mounted in two differens positions.

Seam Finder (50)

The robot can be provided with a system for seam finding (see separate document). An adaptive control program and wiring to the upper arm is necessary for this function.

As an option (50.3) to the Seam Finder, a pneumatically controlled shutter can be ordered. This is an extra protection for the sensor unit, to be used in welding applications.

5.4 Accessories

Separate descriptions of some of the accessories are available.

5.4.1 Control Equipment

Programming unit (100)

The programming unit is used for manual operation and programming of the system. It can be easily connected into the system by means of a cable, fitted with a quick connection plug. The programming unit is fitted with either a 6 m or a 15 m cable.

Floppy disk unit (105)

A floppy disk unit can be connected to the system for entry and storage of programs. It is plugged directly into the control cabinet when inserted in the compartment provided.

Floppy disk (110)

Floppy disks, diameter 5 1/4", are used as the storage medium in the floppy disk unit. The floppy disk can store six separate program blocks on one floppy disk. The floppy disk can also be used as a mass storage device.

Extended program memory (115)

The memory capacity of the user memory can be extended by means of an extra memory board in the electronics rack. The total capacity will then become 32 kword. This corresponds to 3 445 instructions - whereof 50 % are positioning instructions and 50 % are logical instructions. When external axes are included in the system, see "Small motor assembly" on the next page.

Operating time counter (120)

The operating time counter records the time during which the robot is working, i.e. in the OPERATE mode. This makes it easier to schedule preventive maintenance of the robot system and the peripheral equipment.

Terminal units for 24 V power supply (160)

Four terminal units, each consisting of ten terminals strapped together, can be supplied. Each unit can be connected to external or internal 24 V DC or 0 V DC supply, intended for electronics inside the control cabinet.

5.4.2
Mechanical robot

Small motor assembly (300, 305)

The motor assembly is attached as an external axis; it consists of a DC disc motor, tachometer and resolver, together with 15 m cable and connecting plugs. An alternative motor assembly with gear box is also available. The robot system must be equipped with control electronics for one external axis per motor assembly, see section 5.3, Variants of the basic version (1).

The number of instructions in the memory is changed to:

- 605 (8 kword memory)
- 2 425 (32 kword memory)

Solenoid valve unit (315)

The robot can be equipped with a solenoid valve unit to control pneumatic equipment. This can be fitted in the place provided for the purpose. The solenoid valve unit is supplied with one or two 5-port solenoid valves.

N.B. If a solenoid valve unit is to be mounted on the robot, the leads for user connections must be connected to the wrist via the arm system (23).

Guide for alternative synchronization position (335)

In order to synchronize the 1:st (C) axis of the robot in one of the two alternative positions (see section 5.2.2, Functions), the above guide must be used in place of the existing guide inside the body of the robot.

Fan for seam finder, fan voltage, fan frequency (350, 351, 352)

See separate description.

5.4.3
Service

Test adapter for fault tracing in system (500)

The test adapter can be of assistance when a fault in the system has been confirmed, but has not been localized with the help of the error messages displayed, the test points or the LEDs. The test adapter is inserted in the electronics rack and contains a number of test programs which the operator, in a dialogue with the program, can activate from the programming unit. The input and output boards and the whole of the measuring and servo systems can be tested with the test adapter to determine which input/output or module in the measurement/servo system is faulty. The computer and memory boards can also be tested.

Special tool kit (515)

Special tools, supplied as a kit, are required for certain mechanical work on the robot.

Spare parts sets (520 through 526)

Sets of spare parts are supplied for either mechanical or electrical maintenance. Large or small sets of each type can be supplied.

Extension board (530, 531)

Measurements can be carried out on boards, even when they are mounted in the electronics rack, by means of an extension board outside the rack. This board is available in two forms; with a 64-pole process signal connector, and with a 28-pole connector.

Synchronization equipment (537)

The equipment is used for measurement and calibration of the robot synchronization position. The synchronization position can then be registered on installation of the equipment and then checked after exchange of components or when considered necessary.

The equipment consists of:

- Inclinometer with digital display.
- Fixture sets for IRB 6/2, IRB 60/2 and IRB 90/2.

If required, a fixture set only for IRB 6/2 is included in the equipment.

Programming manual (540)

One programming manual is delivered with each robot system. Any additional manuals are to be ordered here.

Product manual (545)

One product manual is delivered with each robot system. Any additional manuals are to be ordered here.

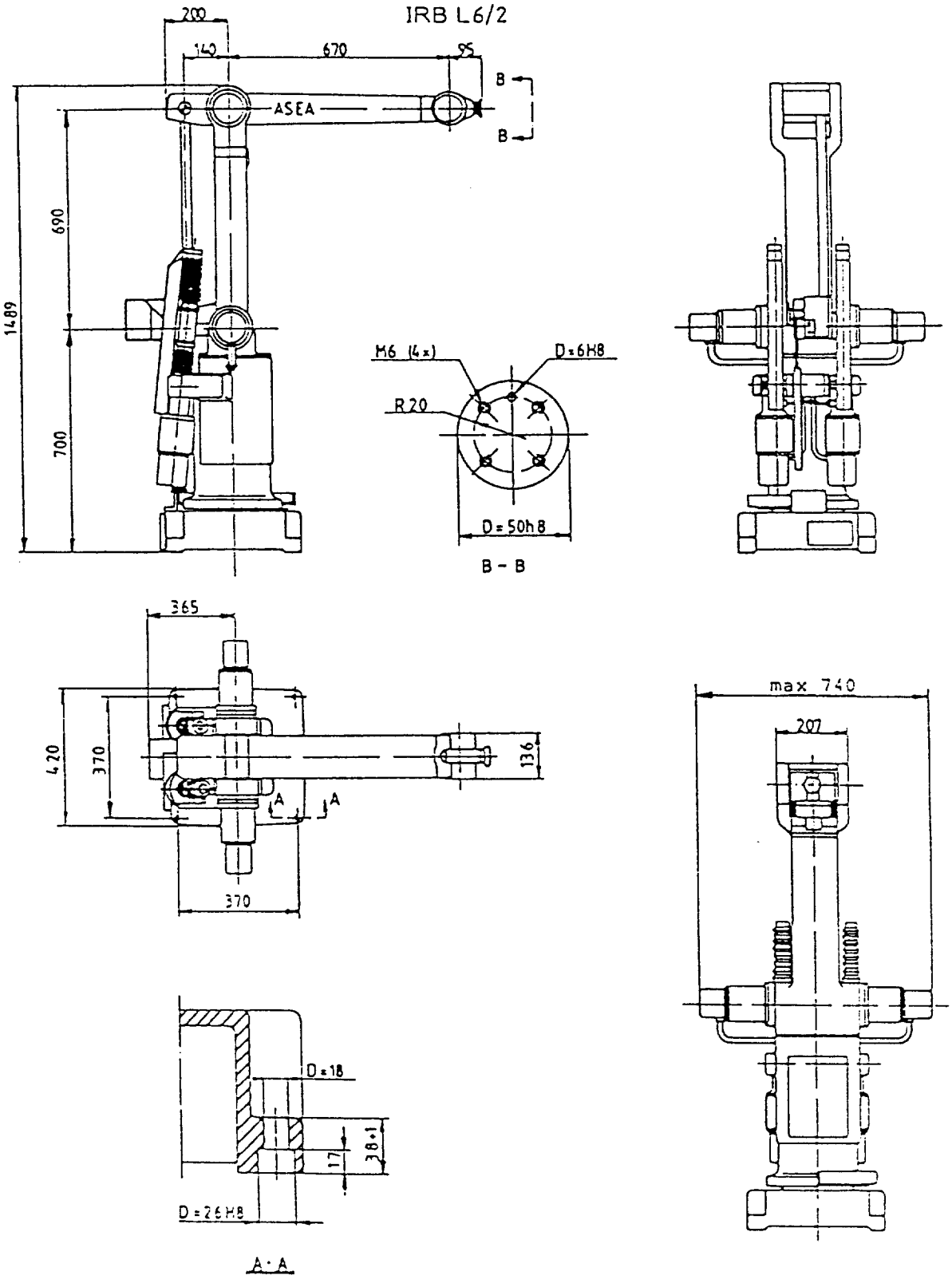
Service manual (550)

No service manual is delivered with the robot system. Any service manuals are to be ordered here. The manual deals in detail with all parts of the robot system. It also includes a list of special tools and recommendations about these.

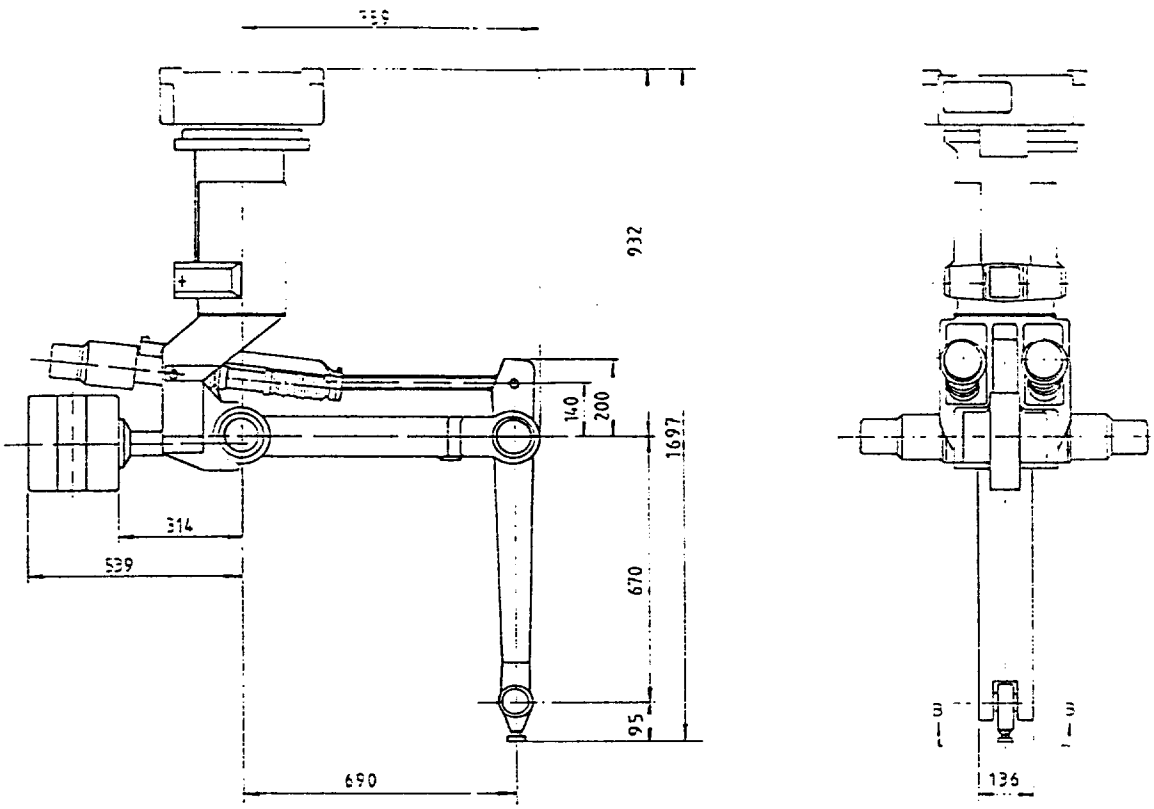
5.5
Dimensioned drawings

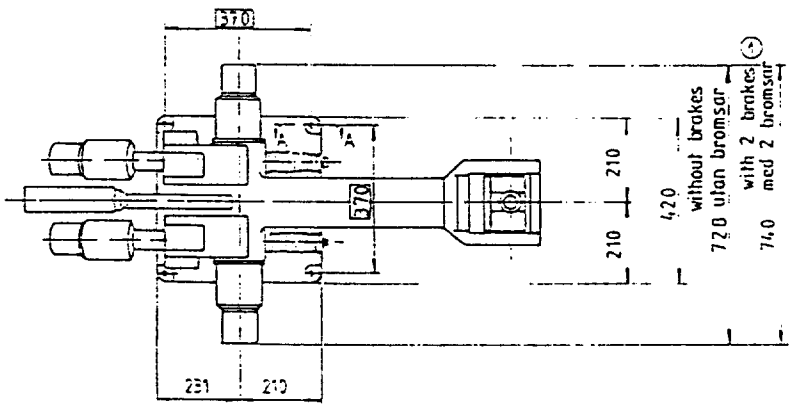
Dimensions in millimetres.

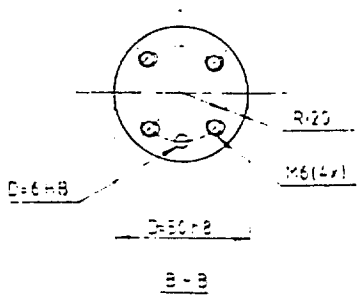
Mechanical robot

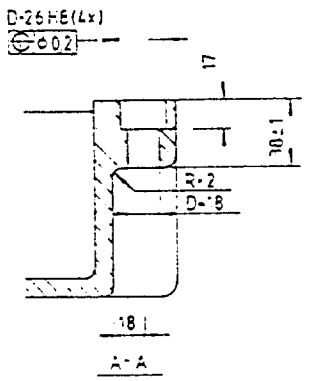


IRB G6/2


932
140
200
1697
314
539
670
95
690
136

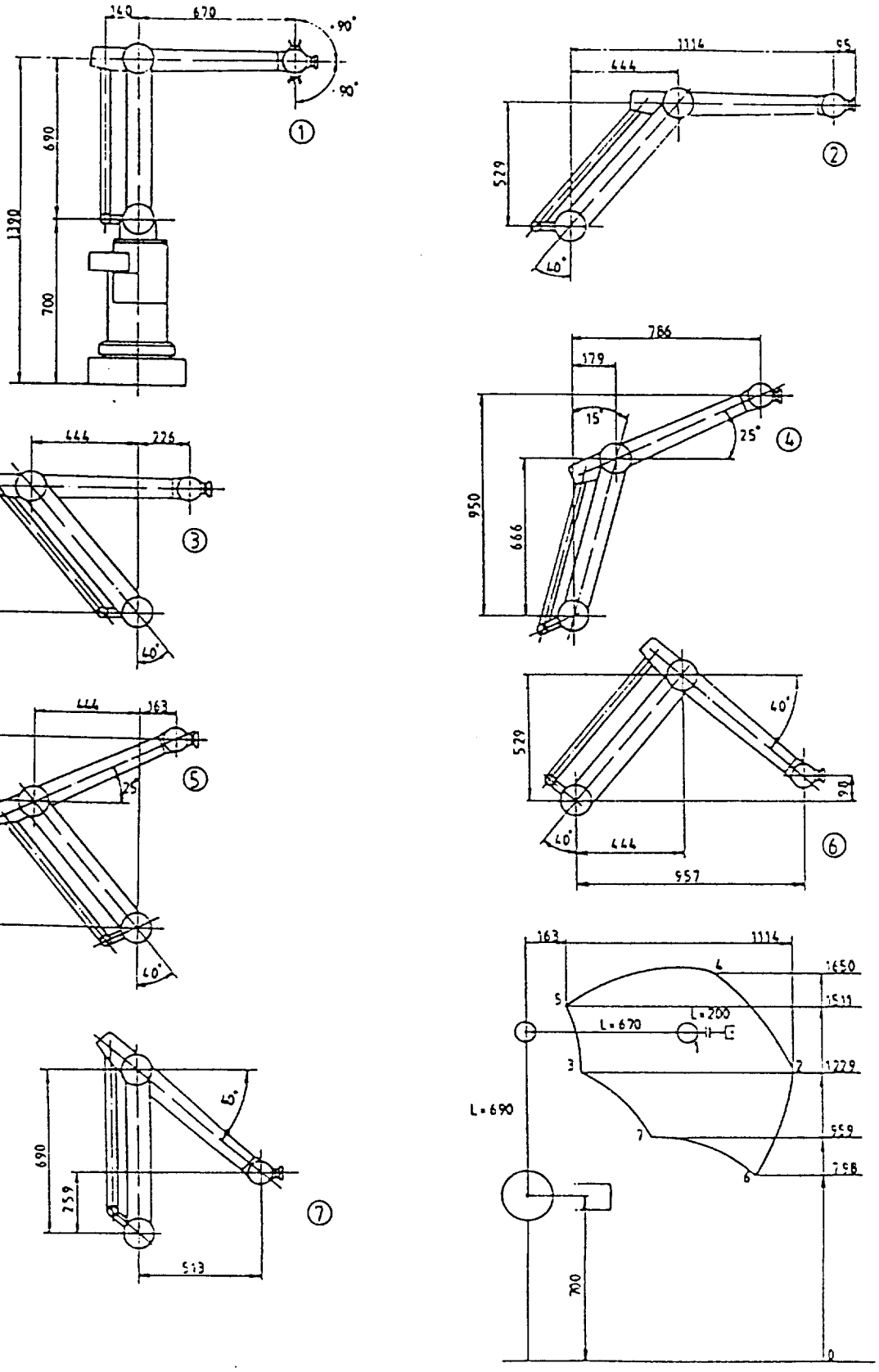

570
210
420
without brakes
720 utan bromsar
with 2 brakes
740 med 2 bromsar
570
231
210


R:20
M6(4x)
D=6 H8
D=50 h8
B - B

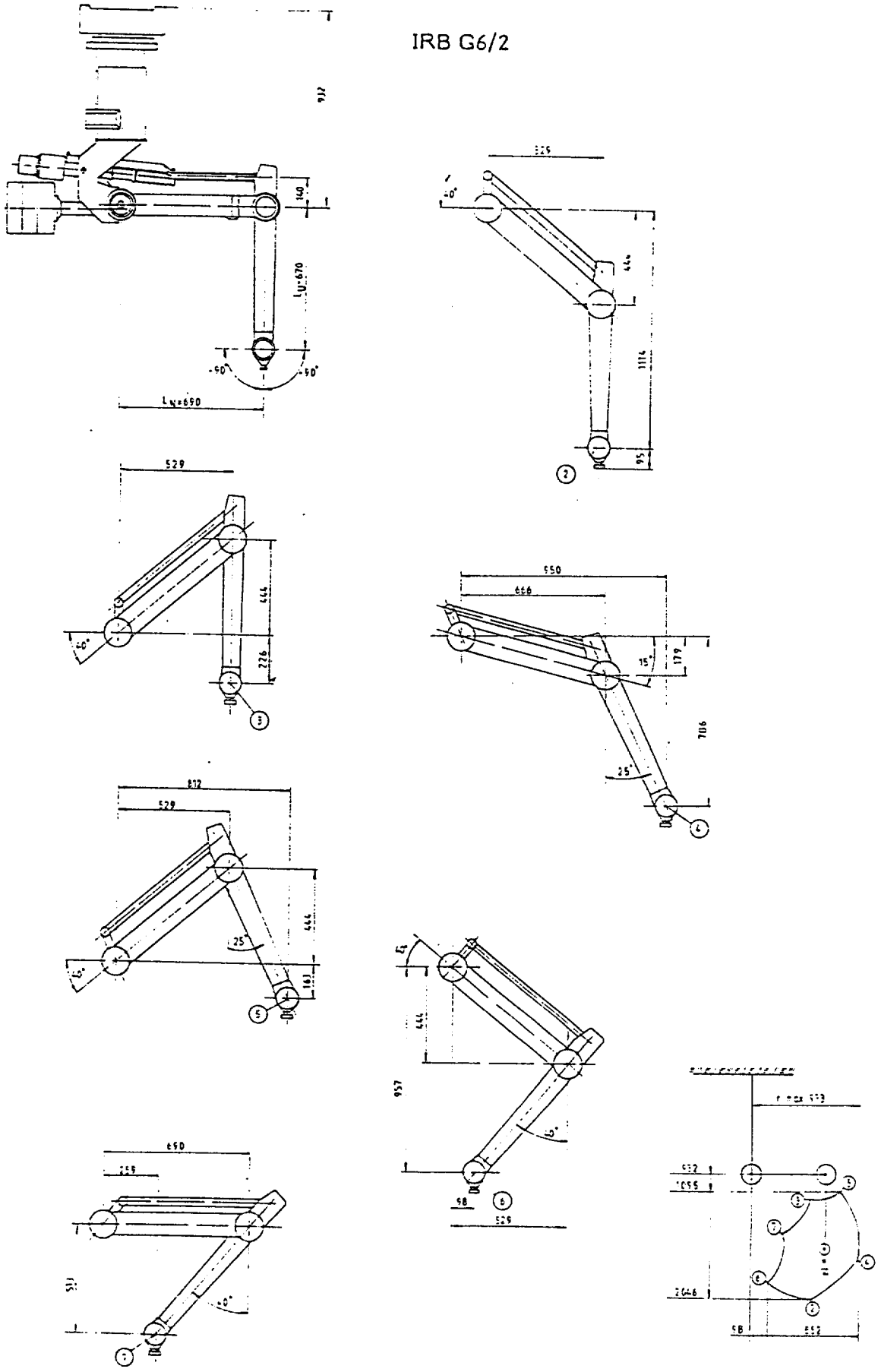

D-26 H8(4x)
0.02
17
10:1
R:2
D:8
18
A - A

Working range with robot axes in extreme positions.

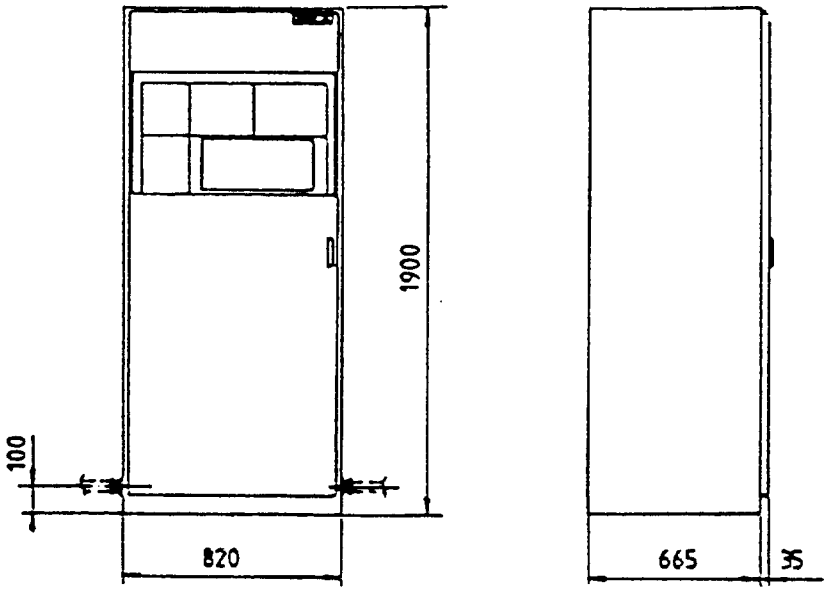
IRB L6/2



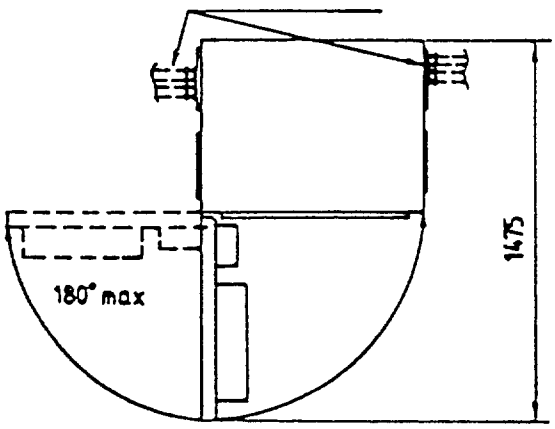
IRB G6/2



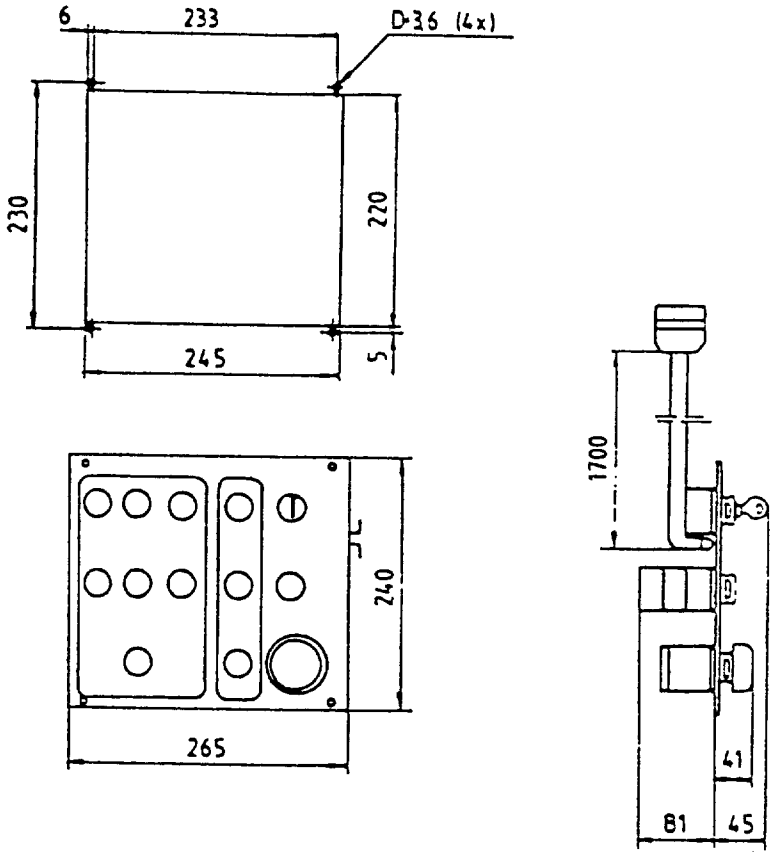
Control cabinet



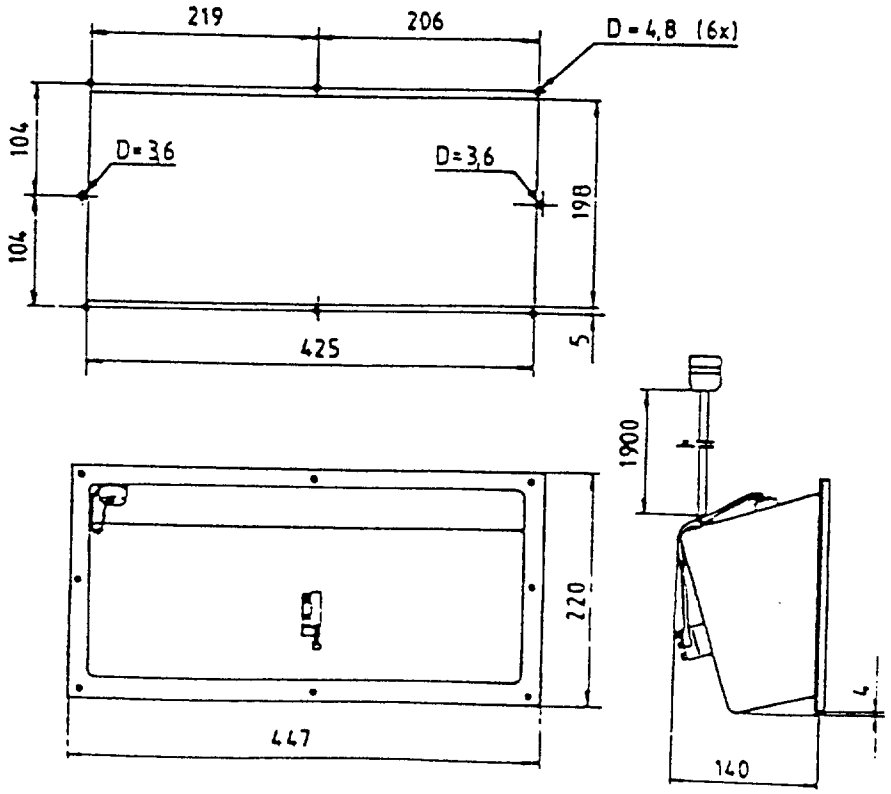
Alternative connection



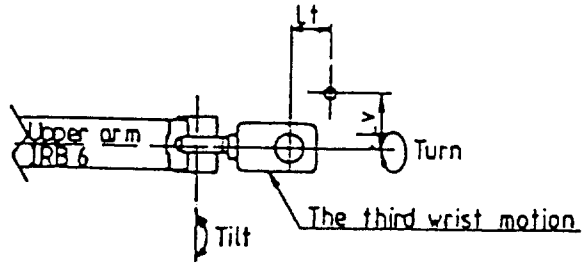
Separate control panel

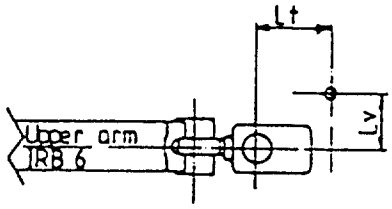


Separate compartment for programming unit

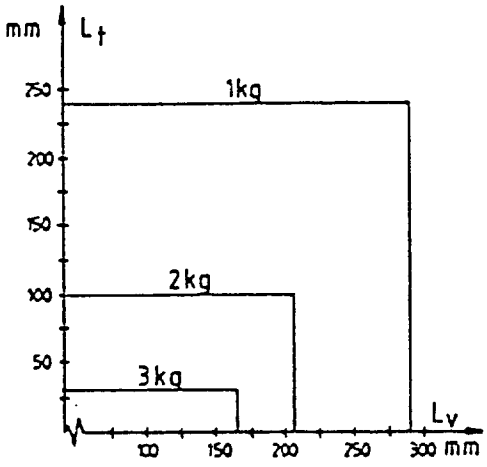


5.6
Loading diagram 6 axes (top) and 5 axes (bottom)

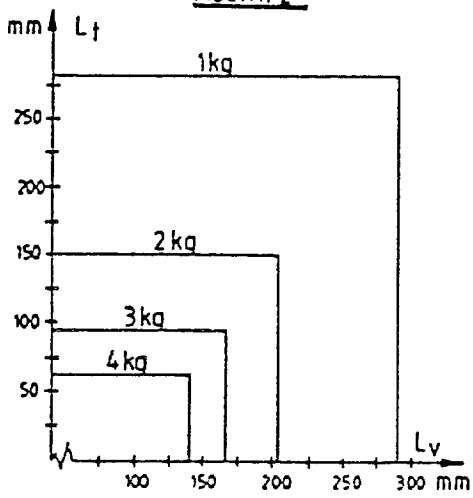


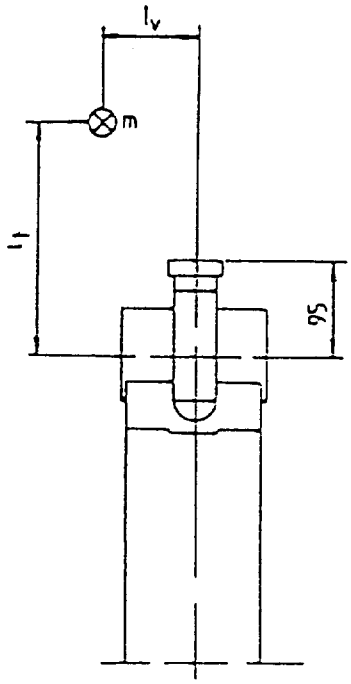


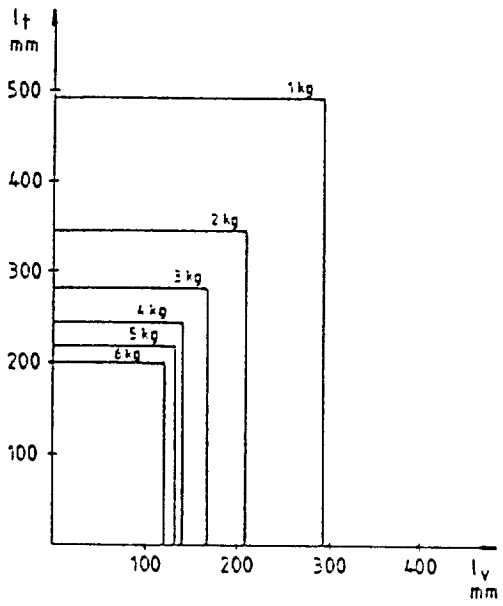
Mount.1



Mount. 2







APPLICATION INFORMATION FORM

JAKA1 86-05-01

UDB:..... UDB Ref No.: ..... Application (description) .....

Sales eng. ..... Appl. eng. ....

End user: ..... Location: ..... OEM:.....

SPECIFICATION FORM FOR STANDARD ROBOT SYSTEM IRB L6/2

BASIC IRB L6/2

1 CONTROL ELECTRONICS FOR EXTERNAL AXES
- ☐ 1.1 No
- ☐ 1.2 1 axis *6)
- ☐ 1.3 2 axes
- ☐ 1.4 3 axes
- ☐ 1.5 4 axes, not with 30.2

2 CABLE LENGTH ROBOT - CONTROL CABINET
- ☐ 2.1 6 m
- ☐ 2.2 10 m
- ☐ 2.3 15 m

3 LOCATION OF CONTROL PANEL
- ☐ 3.1 In control cabinet
- ☐ 3.2 External, 6 m cable
- ☐ 3.3 External, 10 m cable
- ☐ 3.4 External, 15 m cable

4 LOCATION OF COMPARTMENT FOR PROGRAMMING UNIT
- ☐ 4.1 In control cabinet
- ☐ 4.2 External, 6 m cable
- ☐ 4.3 External, 10 m cable
- ☐ 4.4 External, 15 m cable

5 CABLE CONNECTION ON CONTROL CABINET
- ☐ 5.1 Left side, normal
- ☐ 5.2 Right side *4)

6 SAFETY SWITCH
- ☐ 6.1 No
- ☐ 6.2 Yes, on left side *4)

7 MAINS VOLTAGE
- ☐ 7.1 380 V
- ☐ 7.2 415 V
- ☐ 7.3 440 V
- ☐ 7.4 475 V
- ☐ 7.5 500 V
- ☐ 7.6 525 V
- ☐ 7.7 600 V
- ☐ 7.8 220 V

8 MAINS FREQUENCY/FUSES
- ☐ 8.1 50 Hz/D-type
- ☐ 8.2 60 Hz/US-type
- ☐ 8.3 50 Hz/Red Spot type

10 DIGITAL OR ANALOG INPUT/OUTPUT CAPACITY
- ☐ 10.1 Basic capacity only
- 10.2 Extended capacity *8)
  - ☐ 10.2.1 Type DSDI 110 qty .....
  - ☐ 10.2.2 Type DSDI 130 qty .....
  - ☐ 10.2.3 Type DSDX 110 qty .....
  - ☐ 10.2.4 Type DSDO 110 qty .....
  - ☐ 10.2.5 Type DSDO 131 qty .....
  - ☐ 10.2.6 Type DSAI 120 *5)
  - ☐ 10.2.7 Type DSAO 110 *5)

11 DIGITAL UNIT WITH DIRECT INPUTS *1)
- ☐ 11.1 Type 110
- ☐ 11.2 Type 130

12 DIGITAL UNIT WITH STATUS OUTPUTS *1)
- ☐ 12.1 Type 110
- ☐ 12.2 Type 130

14 DEAD MAN'S HANDLE
Requires 16.2.
- ☐ 14.1 Yes (recommended)
- ☐ 14.2 No

16 BRAKE ON ROBOT AXIS
- ☐ 16.1 A- and B-axes
- ☐ 16.2 A-, B-, E- and P-axes
- ☐ 16.3 No (standard)

17 DOCUMENTATION
- ☐ 17.1 None
- ☐ 17.2 Swedish
- ☐ 17.3 English

21 PROGRAMMING LANGUAGE
- ☐ 21.1 Eng,Ger,Fr,Du
- ☐ 21.2 Eng,It,Sp,Po
- ☐ 21.3 Eng,Jap,Fin,Swe

22 LOCAL REQUIREMENTS
(See Description)
- ☐ 22.1 No
- ☐ 22.2 Yes

23 ADDITIONAL FUNCTIONS
- ☐ 23.1 No
- 23.2 Yes, one or a combination of:
  - ☐ 23.2.1 Prog.print out *4)
  - ☐ 23.2.2 Remote control Only with 3.1.
  - ☐ 23.2.3 Monitor, not with 50.2
  - ☐ 23.2.4 Monitor, if Vision
  - ☐ 23.2.5 Automatic restart *9)
  - ☐ 23.2.50 Cables upper arm

24 ADDITIONAL PROGRAM FUNCTIONS
- ☐ 24.1 No
- ☐ 24.2 Added functions
- ☐ 24.3 Adaptive control, incl. 3D autoframe *2)
- ☐ 24.4 Computer link, incl 24.3

25 ADDITIONAL EQUIPMENT
- ☐ 25.1 No
- 25.2 Yes, one or a combination of
  - ☐ 25.2.1 Inspection window
  - ☐ 25.2.2 Door interlock
  - ☐ 25.2.3 Earth fault protection

26 VISION FUNCTION
- ☐ 26.1 No
- ☐ 26.2 Yes

30 THIRD WRIST MOTION
- ☐ 30.1 No
- ☐ 30.2 Yes, 23.2.50 included

50 SEAM FINDER IRBS 101
- ☐ 50.1 No
- ☐ 50.2 Yes *7)
- ☐ 50.3 Yes, + Shutter *7)

OPTIONAL ACCESSORIES IRB L6/2

For control equipment

100 PROGRAMMING UNIT
- ☐ 100.1 6 m cable
- ☐ 100.2 15 m cable

☐ 105 FLOPPY DISK UNIT

☐ 110 FLOPPY DISK, qty .....

☐ 115 EXTENDED MEMORY

120 OPERATING TIME COUNTER
- ☐ 120.1 For 50 Hz
- ☐ 120.2 For 60 Hz

☐ 160 TERMINAL UNIT FOR 24 V POWER SUPPLY

For mechanical robot

☐ 300 MOTOR SET, qty ..... SMALL

☐ 305 MOTOR SET, qty ..... SMALL WITH GEAR

315 SOLENOID VALVE UNIT *3)
- ☐ 315.1 1 valve
- ☐ 315.2 2 valves, only with 30.1.

☐ 335 ALTERNATIVE SYNC. BAR

☐ 350 FAN FOR SEAM FINDER Max. 2 seam finders/fan

351 FAN VOLTAGE
- ☐ 351.1 220 V
- ☐ 351.2 380 V
- ☐ 351.3 415 V
- ☐ 351.4 440 V
- ☐ 351.5 475 V
- ☐ 351.6 500 V
- ☐ 351.7 525 V
- ☐ 351.8 600 V

352 FAN FREQUENCY
- ☐ 352.1 50 Hz
- ☐ 352.2 60 Hz

For service

☐ 500 TEST ADAPTER

☐ 515 SPECIAL TOOL SET

☐ 520 ELECTRICAL SPARE PARTS SMALL SET

☐ 521 ELECTRICAL SPARE PARTS LARGE SET

☐ 525 MECHANICAL SPARE PARTS SMALL SET

☐ 525.1 Mech. spare parts, small set for robots with automatic restart

☐ 526 MECHANICAL SPARE PARTS LARGE SET

☐ 526.1 Mech. spare parts, large set for robots with automatic restart

☐ 530 EXTENSION BOARD, 64 POLE

☐ 531 EXTENSION BOARD, 28 POLE

537 SYNC. EQUIPMENT
- ☐ 537.1 Complete IRB 6/60/90
- ☐ 537.50 IRB 6 only

For documentation

☐ 540 PROGRAMMING MANUAL, ... extra sets

☐ 545 PRODUCT MANUAL, ... extra sets

☐ 550 SERVICE MANUAL, ... sets

1) Only when extended capacity and more than one type of digital input/output unit is selected acc to pos 10.2.
2) Requires cables upper arm (23.2.50) if sensors are to be mounted on robot, but not if Third wrist motion (30.2) is specified. Includes 24.2.
3) Requires cables upper arm (23.2.50), but not if Third wrist motion (30.2) is specified.
4) Combination of pos 5.2, 6.2 and 23.2.1 is not allowed.
5) Requires Added function (24.2 to 24.4).
6) If robot is used together with track motion (IRBT 06S), the control electronic for first external axis should be used for this. If the robot is equipped with third wrist motion, a separate quotation should be requested for the track motion.
7) Requires: a) cables upper arm (23.2.50), but not if Third wrist motion (30.2) is specified. b) Fan for Seam Finder (350). c) Adaptive control program (24.3). Please specify! Cannot be combined with 23.2.3, Monitor.
8) Up to four input/output units can be chosen (10.2) but up to three input/output units if Seam Finder IRBS 101 (50.2) is specified.
9) It is not possible to have a third wrist motion on a robot with automatic restart. Furthermore, there are brakes on axes 1 - 5.

MODIFICATIONS ACCORDING TO J QUOTATION No.: .....

J Order No.: .....

APPLICATION INFORMATION FORM

UDB: ..... UDS Ref No.: ..... Application (description) .....

Sales eng. ..... Appl. eng. ....

End user: ..... Location: ..... OEM: .....

SPECIFICATION FORM FOR STANDARD ROBOT SYSTEM IRB G6/2

BASIC IRB G6/2

1 CONTROL ELECTRONICS FOR EXTERNAL AXES
- ☐ 1.1 No
- ☐ 1.2 1 axis *6)
- ☐ 1.3 2 axes
- ☐ 1.4 3 axes
- ☐ 1.5 4 axes, not with 30.2

2 CABLE LENGTH ROBOT - CONTROL CABINET
- ☐ 2.1 6 m
- ☐ 2.2 10 m
- ☐ 2.3 15 m

3 LOCATION OF CONTROL PANEL
- ☐ 3.1 In control cabinet
- ☐ 3.2 External, 6 m cable
- ☐ 3.3 External, 10 m cable
- ☐ 3.4 External, 15 m cable

4 LOCATION OF COMPARTMENT FOR PROGRAMMING UNIT
- ☐ 4.1 In control cabinet
- ☐ 4.2 External, 6 m cable
- ☐ 4.3 External, 10 m cable
- ☐ 4.4 External, 15 m cable

5 CABLE CONNECTION ON CONTROL CABINET
- ☐ 5.1 Left side, normal
- ☐ 5.2 Right side *4)

6 SAFETY SWITCH
- ☐ 6.1 No
- ☐ 6.2 Yes, on left side *4)

7 MAINS VOLTAGE
- ☐ 7.1 380 V
- ☐ 7.2 415 V
- ☐ 7.3 440 V
- ☐ 7.4 475 V
- ☐ 7.5 500 V
- ☐ 7.6 525 V
- ☐ 7.7 600 V
- ☐ 7.8 220 V

8 MAINS FREQUENCY/FUSES
- ☐ 8.1 50 Hz/D-type
- ☐ 8.2 60 Hz/US-type
- ☐ 8.3 50 Hz/Red Spot type

10 DIGITAL OR ANALOG INPUT/OUTPUT CAPACITY
- ☐ 10.1 Basic capacity only
- 10.2 Extended capacity *8)
  - ☐ 10.2.1 Type DSDI 110 qty .....
  - ☐ 10.2.2 Type DSDI 130 qty .....
  - ☐ 10.2.3 Type DSDX 110 qty .....
  - ☐ 10.2.4 Type DSDO 110 qty .....
  - ☐ 10.2.5 Type DSDO 131 qty .....
  - ☐ 10.2.6 Type DSAI 120 *5)
  - ☐ 10.2.7 Type DSAO 110 *5)

11 DIGITAL UNIT WITH DIRECT INPUTS *1)
- ☐ 11.1 Type 110
- ☐ 11.2 Type 130

12 DIGITAL UNIT WITH STATUS OUTPUTS *1)
- ☐ 12.1 Type 110
- ☐ 12.2 Type 130

14 DEAD MAN'S HANDLE
Requires 16.2.
- ☐ 14.1 Yes (recommended)
- ☐ 14.2 No

16 BRAKE ON ROBOT AXIS
- ☐ 16.1 A- and B-axes (standard)
- ☐ 16.2 A-, B-, E- and P-axes
- ☐ 16.3 No

17 DOCUMENTATION
- ☐ 17.1 None
- ☐ 17.2 Swedish
- ☐ 17.3 English

21 PROGRAMMING LANGUAGE
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  - ☐ 23.2.2 Remote control Only with 3.1.
  - ☐ 23.2.3 Monitor, not with 50.2
  - ☐ 23.2.5 Automatic restart *9)
  - ☐ 23.2.50 Cables upper arm

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- ☐ 30.1 No
- ☐ 30.2 Yes, 23.2.50 included.

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- ☐ 50.1 No
- ☐ 50.2 Yes *7)
- ☐ 50.3 Yes, - Shutter *7)

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☐ 115 EXTENDED MEMORY

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- ☐ 351.2 380 V
- ☐ 351.3 415 V
- ☐ 351.4 440 V
- ☐ 351.5 475 V
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- ☐ 351.7 525 V
- ☐ 351.8 600 V

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- ☐ 352.1 50 Hz
- ☐ 352.2 60 Hz

For service

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☐ 525 MECHANICAL SPARE PARTS SMALL SET

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☐ 530 EXTENSION BOARD, 64 POLE

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- ☐ 537.1 Complete IRB 6/60/90
- ☐ 537.50 IRB 6 only

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4) Combination of pos 5.2, 6.2 and 23.2.1 is not allowed.
5) Requires Added function (24.2 to 24.4).
6) If robot is used together with track motion (IRBT 06S), the control electronic for first external axis should be used for this. If the robot is equipped with third wrist motion, a separate quotation should be requested for the track motion.
7) Requires: a) cables upper arm (23.2.50), but not if Third wrist motion (30.2) is specified. b) Fan for Seam Finder (350). c) Adaptive control program (24.3). Please specify!
8) Up to four input/output units can be chosen (10.2) but up to three input/output units if Seam Finder IRBS 101 (50.2) is specified.
9) It is not possible to have a third wrist motion on a robot with automatic restart. Furthermore, there are brakes on axes 1 - 5.

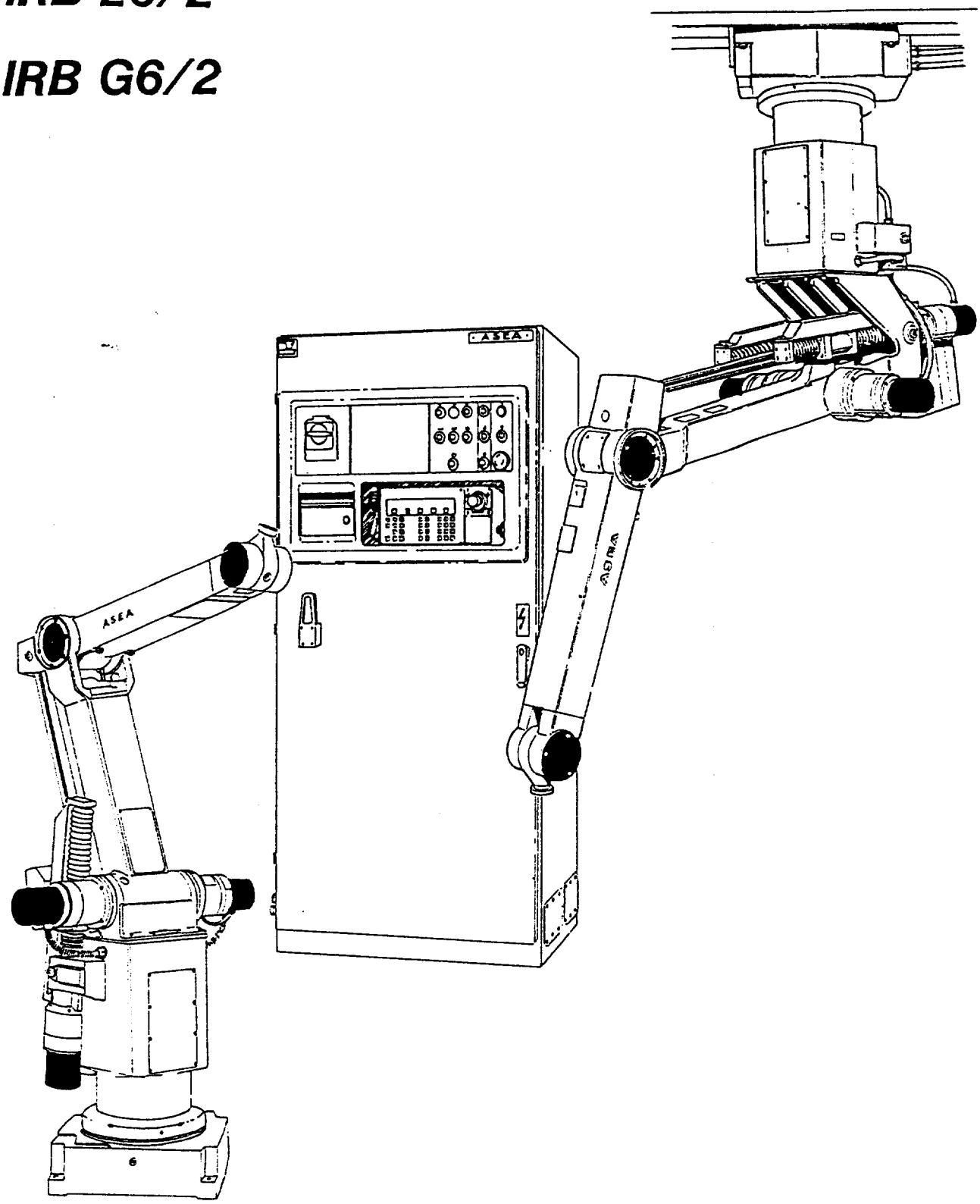
MODIFICATIONS ACCORDING TO J QUOTATION No.: .....

ASEA

INDUSTRIAL ROBOT SYSTEM

IRB L6/2

IRB G6/2



5397 014-101 Part of Product Manual CF 09-8015E

CK 09-1301E SEPT 1986 INSTALLATION

ASEA

Contents

1
INTRODUCTION

This manual describes the installation and preparation for operations of the robot system.

All electrical connections of signals to and from the basic robot and the control equipment and their function are described.

Connection methods, cable selection and safety precautions are also discussed.

References: System Circuit Diagram
Programming Manual
Service Manual

IMPORTANT: Read the SAFETY PRECAUTIONS in Chapter 12 before beginning the installation and follow the instructions given.

2
UNCRATING AND HANDLING

After the equipment has been uncrated, inspect for any external damage to cabinet, control panel or programming unit and ensure that all electrical contacts and circuit boards are properly inserted and that all function units in the cabinet are fixed securely and all screws tightened.

If the field connections cannot be begun immediately, the equipment should be stored indoors with temperature between 0 ^{o} and 50 ^{o}C.

The robot (without brakes) and control cabinet can be lifted as shown in Figure 2-1. How to lift a robot with brakes is described in section 2.1.

The IRB L6/2 has a total weight of 145 kg, the IRB G6/2 weighs 170 kg and the cabinet weighs 350 kg.

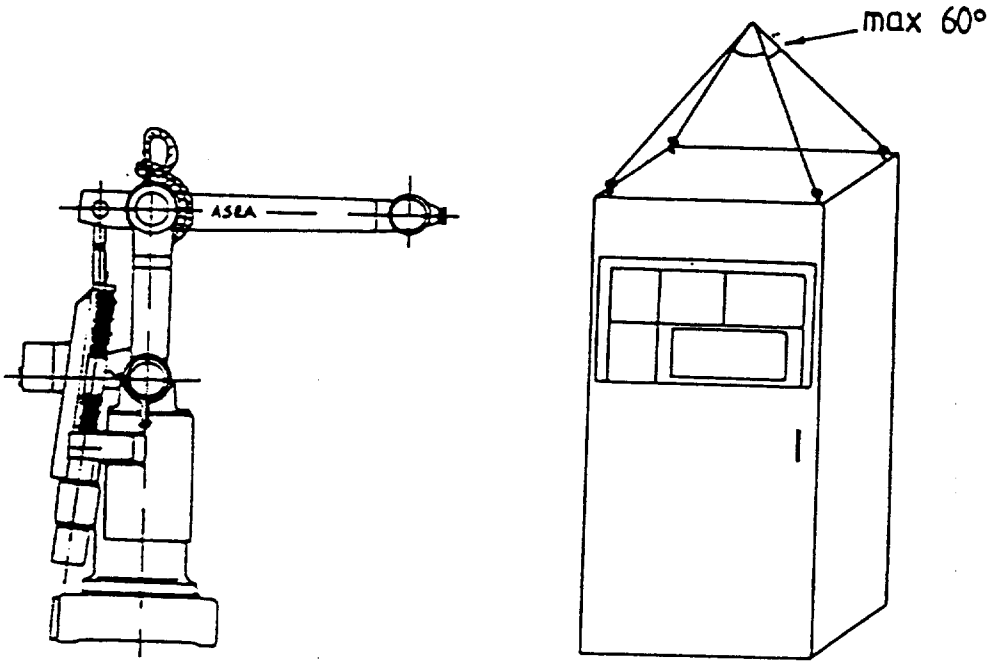


Figure 2-1

2.1
Lifting an IRB L6/2 with brakes

Use two straps. Wind them around the 4:th and 5:th axes motors as close as possible to the body.

N.B. Mind the motor cables!
(see Figure 2-2).

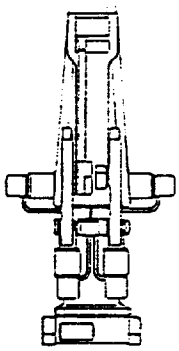


Figure 2-2

2.2
Lifting a suspended IRB L6/2

For suspending the robot upside down, three lifting devices are required, one fork lift, for moving the robot to the suspension point and two to enable turning the robot around.

Proceed as follows:

1. Raise the robot a bit with straps wound around the motors, see Figure 2-2 above.

2. Wind another strap around the body.

3. Raise the body slowly with the lower strap only to start the turning of the robot (see Figure 2-3).

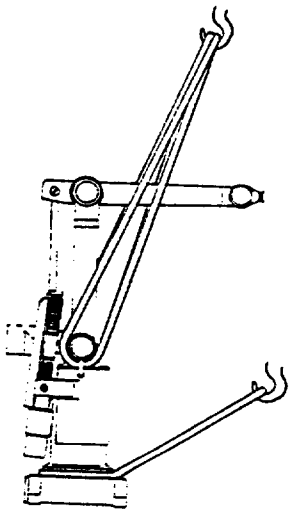


Figure 2-3

4. Keep on raising the body slowly until the robot hangs upside down in the strap around the body.

5. Move the fork lift into position under the robot and raise the fork until the robot base leans on the fork.

6. Lower the robot with the straps around the motors only until the straps hang loose.

7. Remove the straps around the motors.
N.B! Never try to remove tightened straps! You can hurt your fingers badly if they get stuck between strap and motor.

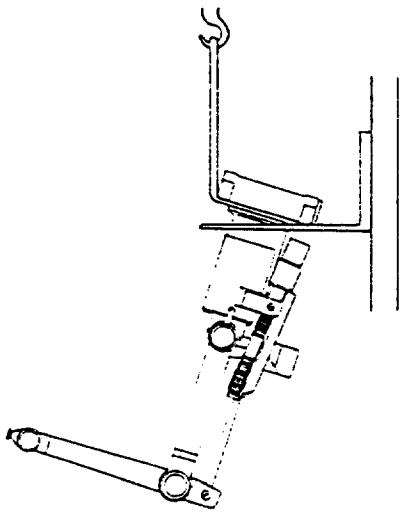


Figure 2-4

8. Lower the robot or raise the fork until the robot base is suspended on the fork and the strap hangs loose. The fork can either fit on the robot body (Figure 2-5) or the robot base (Figure 2-6).

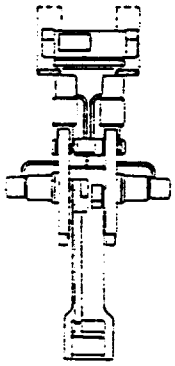


Figure 2-5

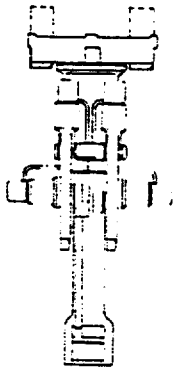


Figure 2-6

9. Remove the strap around the robot base.

   N.B! Never try to remove a tightened strap! You can hurt your fingers badly if they get stuck between the strap and the robot.

10. Move the robot to the position for suspension.

2.3
Lifting an IRB G6/2

Since the robot is delivered standing up, and is to be mounted in an inverted fashion, it will have to be turned before it can be mounted.

To carry out the turning procedure, a fork-lift and a telpher with two lifting slings (or similar), will be needed. The lifting device must have a minimum capacity of 200 kg.

N.B! Under no circumstances must the lifting slings be attached to the arm of the robot when lifting, since this can damage the ball screw unit. The slings must be attached to axis 2 (B), according to Figure 2-7.

The following steps are recommended at the turning procedure:

1) Wrap a lifting strap around the robot, as shown in Figure 2-7.

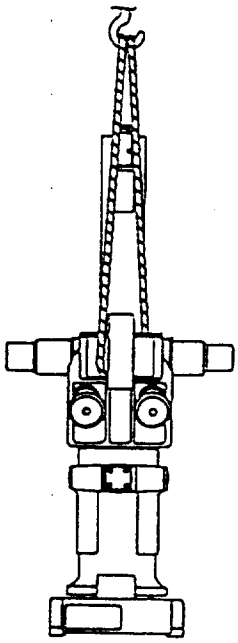


Figure 2-7

2. Raise the robot approximately 0.5 m with the fork-lift.

3. Wrap another strap around the body or the base.

4. Lift the body/base with the telpher (or similar) to make the robot turn. See Figures 2-8 and 2-9.

   N.B! The turning procedure must be executed with the greatest of care, so that e.g. the strap that is attached to the fork-lift will not come off.

Telpher alt. fork-lift

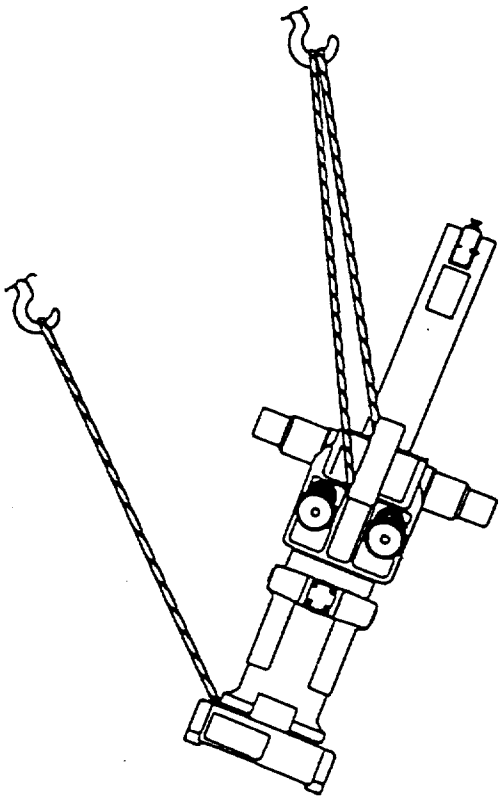


Figure 2-8

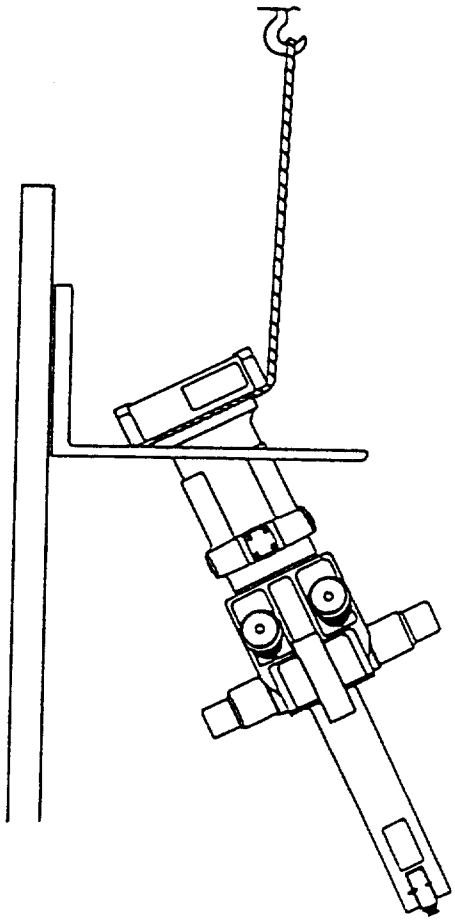


Figure 2-9

5. When the turning is completed, first remove the strap mentioned in paragraph 1.

   N.B! Never try to remove a tightened strap! Your fingers may be hurt badly if they get stuck between the strap and the robot.

6. The robot is then hung by its base (alternatively the flange near the base) from the fork of the fork-lift. See Figure 2-10.

7. The robot can now be taken to the mounting site.

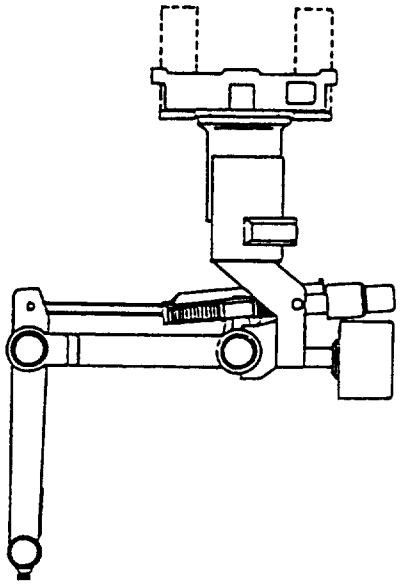


Figure 2-10

N.B! Care must be taken, when moving the robot on the fork-lift, to ensure that it will not slide out from the fork, e.g. when stopping the fork lift.

3
EQUIPMENT INSTALLATION

Mechanical Robot

The surface on which the robot is to be mounted is to be level. The robot is to be fixed to prevent displacement relative to its base.

The details of the fixing with four bolts, type Socket head cap screws M16 x 140. Their location, size and spacing are shown in Figure 3-1.

Mounting using sleeves is one example of how to mount the robot.

Note: Expander bolts are suitable for this purpose!

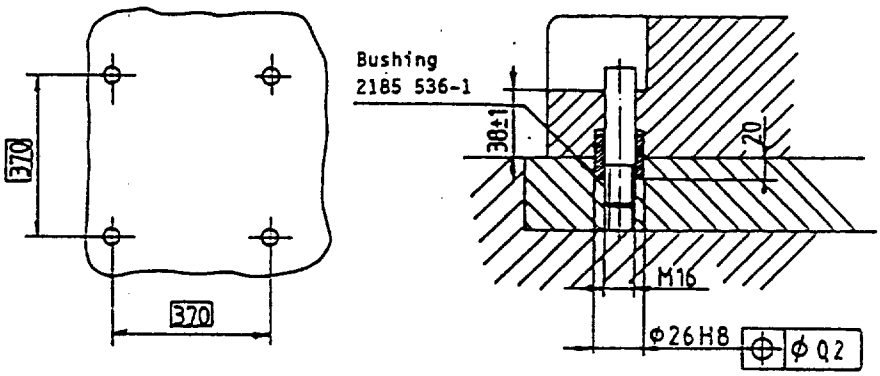
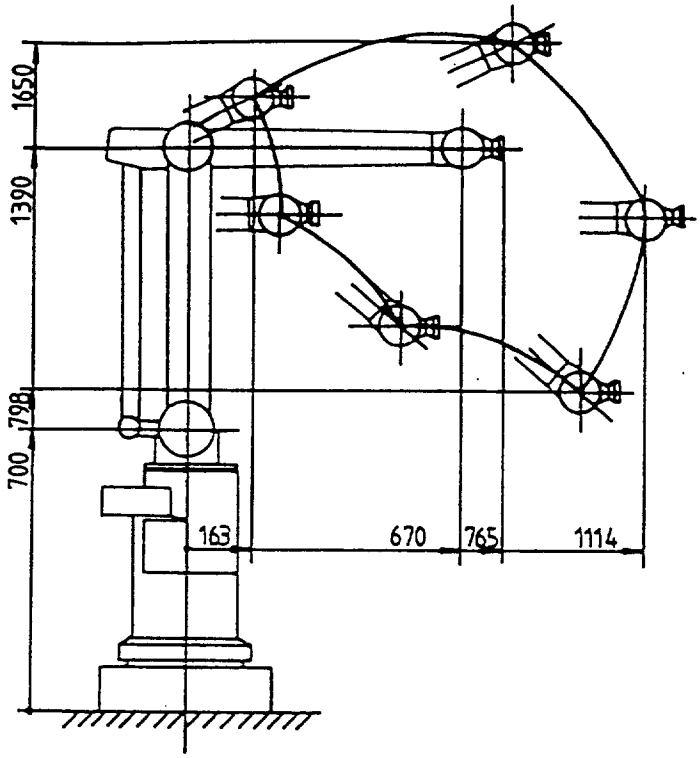


Figure 3-1

The necessary space and the working range of the mechanical robot are shown in Figures 3-2 and 3-3.

Three different synchronization positions are possible for axis 1 (C). These along with the synchronization positions of the other axes are shown in section 10.2 for IRB L6/2 and IRB G6/2.


1650
1390
798
700
163
670
765
1114

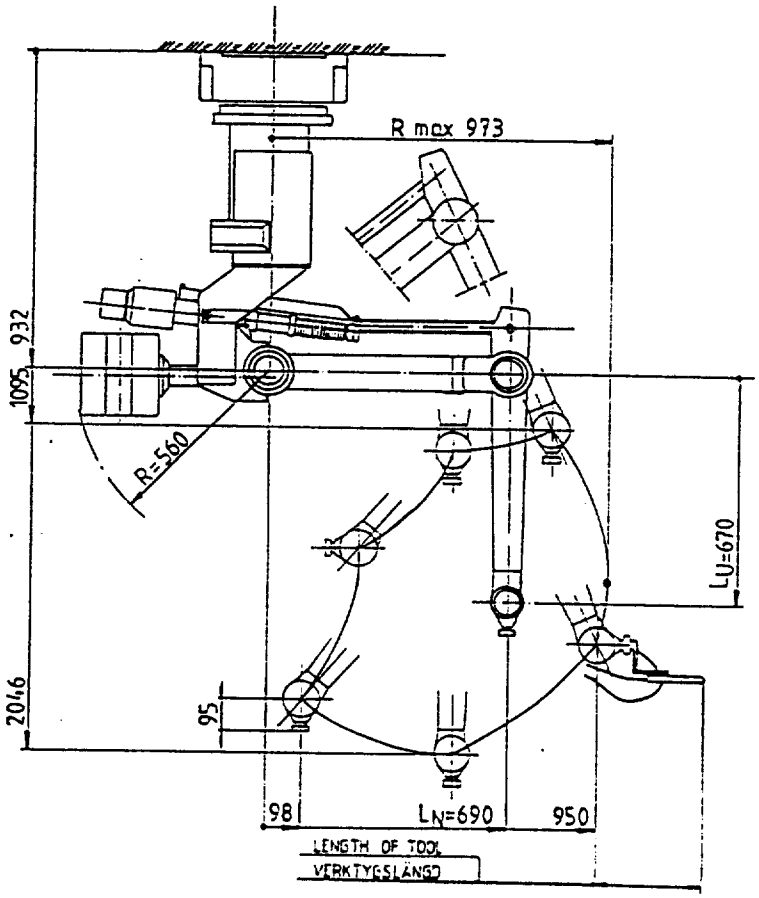

R max 973
932
1095
R=560
LU=670
2046
95
98
LN=690
950
LENGTH OF TOOL
VERKTYGSLÄNGD

Figure 3-2

Control cabinet

When installed, at least 10 cm free space is to be left around the cabinet and it must be possible to open the front door at least 180° for servicing, see figure 3-3.

The control cabinet is normally delivered for connection of the external wiring at the left side but the connection can be provided at the right side if ordered.

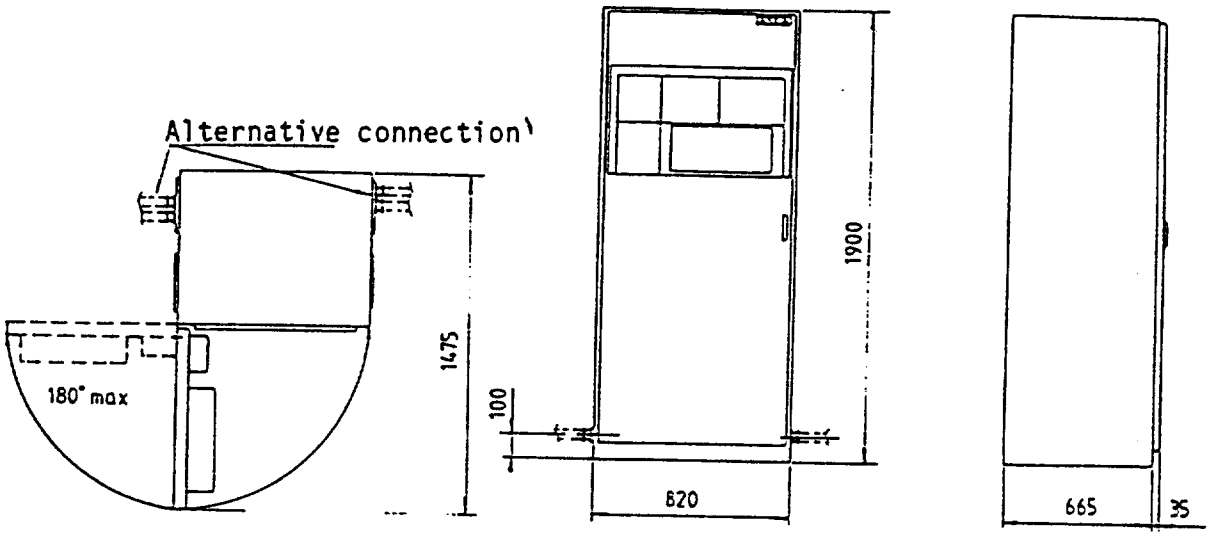


Figure 3-3

Programming unit compartment and control panel

These are normally installed in the front door of the control cabinet but can be delivered for external installation (see section 6.6). The front door is then provided with cover plates to cover the vacant spaces.

Maximum cable connections between control cabinet and:

Mechanical robot	15 m
External axes (motor, tacho, resolver)	15 m
Digital and analog inputs/outputs	30 m
External control panel	30 m
External programming unit compartment (excluding programming unit cable)	15 m

Robot and control cabinet environment

The control cabinet must not be exposed to radiant heat.

The mechanical robot is strongly built and resistant to environmental effects but its mechanical parts should be protected from fluids (e.g. coolant) and abrasive dust particles.

Control equipment: *)

Ambient temperature	
Control cabinet	+5 °C - +45 °C
Programming unit	+5 °C - +50 °C
Floppy disk unit	+10 °C - +45 °C
Relative humidity	max 90 %
Protection class	IP 54

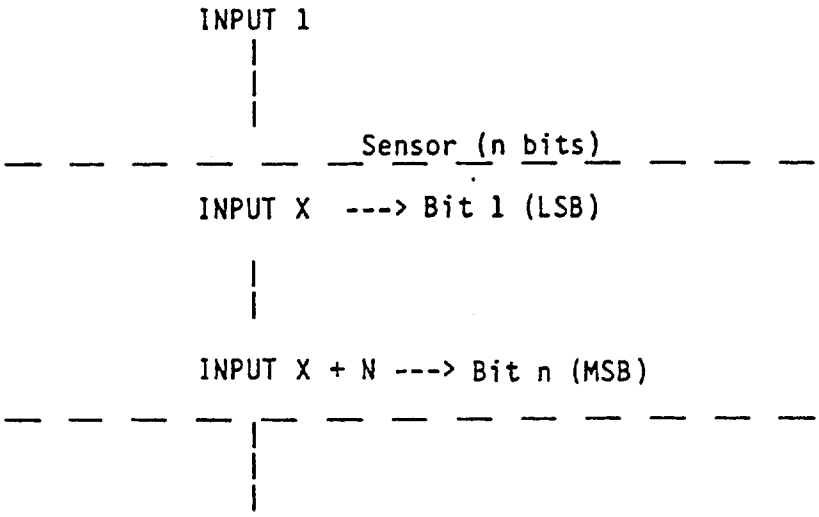
Mechanical robot:

Ambient temperature	
Motors	+5 °C - +50 °C
Upper arm and wrist	+5 °C - +80 °C
Relative humidity	max 90 %

N.B. The floppy disk unit must be handled carefully and protected from dust, damp and physical damage.

*) Applies to floppy disk only when installed in its compartment with hatch closed. The contents of the floppy disk may be destroyed if the temperature limit is exceeded. A thermal monitor in the cabinet disconnects voltage to the control system if the temperature limit is exceeded.

The number of bits for each sensor and at which input the first bit (LSB) is to be connected are indicated with sensor data, see section 10.3. The succeeding bits are connected on the preceding inputs, as follows:



X Input for connection of the first bit of the sensor (Least Significant Bit).

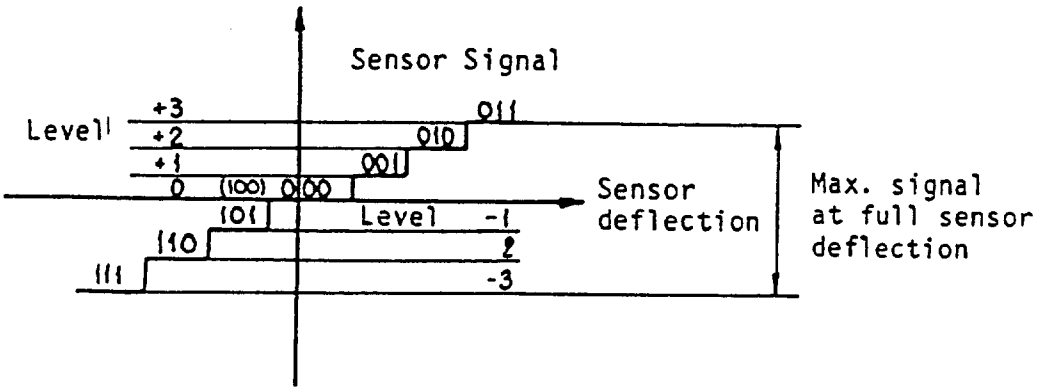
X + N = Input for connection of the last bit of the sensor (Most Significant Bit). If n > 2, this constitutes the sign bit.

N.B. Inputs X and X + N must both be in the same group. See table below:

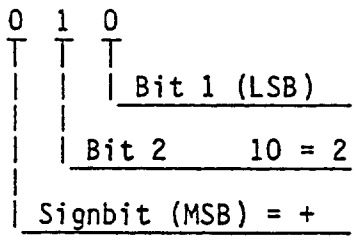
Group	Input no	Nr.of bits
1	1-7	7
2	8-14	7
3	15-22	8
4	23-30	8
5	31-38	8
etc	etc	All succeeding groups contain 8 bits.

Example:

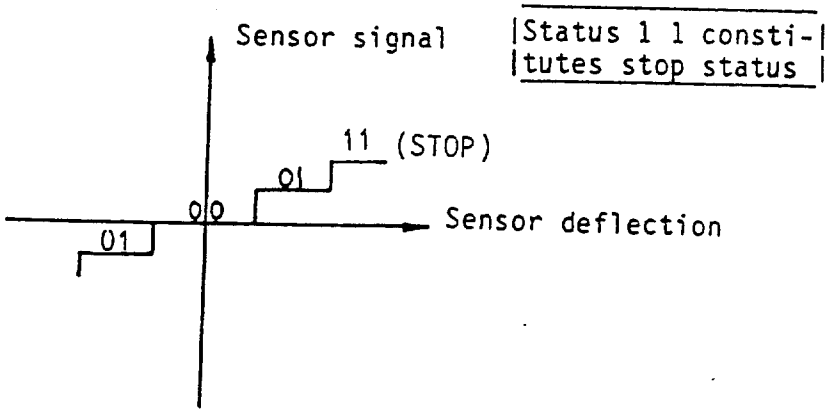
1. Sensor of multi-level type with 3 bits.
   The characteristic for the sensor then becomes the following:



Level +2 is given by 010 where:



2. Sensor of three level type with 2 bits.
   The characteristic becomes the following:



7.3 External axes

References:

Service Manual for:
1) Adjustment of synchronization position
2) Trimming of drive unit

System Circuit Diagram for:
1) Change of jumpers on the drive unit
2) Change of tacho connection to the drive unit

Only the general electrical connections of the external axes are described in this section. See the separate documentation for the mechanical installation and description of the external axes.

7.3.1 General

The control system can be delivered with control electronics and drive units for servo control of up to nine axes. Of these, axes 6 - 9 can be used as external axes. If the robot is equipped with a Third Wrist Motion, axes 7 - 9 can be used as external axes. The control of these is synchronized with that of the robot.

An external axis consists of a DC motor, provided with a tachometer and a resolver. A synchronizing switch is to be connected for each external axis.

7.3.2 Connection

An external axis is to be defined with function parameters, see Chapter 10.

External axes are connected to RTXG connectors in the control cabinet via cable glands, at output F1. See Chapter 13 for installation of RTXG connectors.

The connections of the different axes are shown in Figures 7-5 to 7-8. Note that the cable length should not exceed 15 m.

The external axes should not be connected at the first start-up of the system, see Chapter 9. This is to avoid the risk of the axes unintentionally "racing" before the drive units have been trimmed. See Service Manual.

Direction of rotation

For the direction of rotation of the motor to be correct, positive voltage at M+ (Figures 7-5 -- 7-8) is to give positive rotation direction of the motor shaft (Figure 7-3).

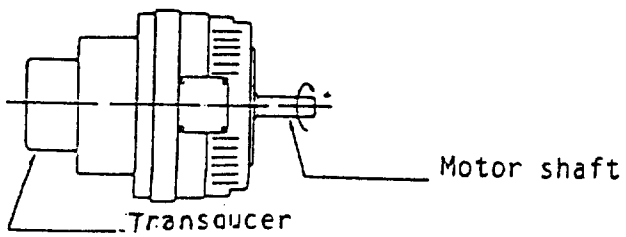


Figure 7-3

Synchronization switches

Synchronization switches are to be of the ON/OFF-type. When synchronizing, the axes rotates in a positive direction if the switch is in the OFF position and in a negative direction if the switch is in the ON position.

The switch is to be connected according to Figure 7-4 for the axis to automatically go to the synchronization position, irrespective of on which side of this the axis is.

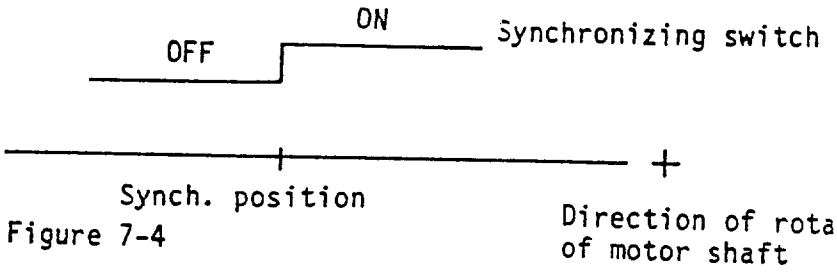


Figure 7-4

The following is a table of technical data for supply of the external axes and certain preset straps and connections.

Table 7-1

Technical data		Notes
Voltage, Nom	45 V	
Current, Nom Max	8 A 15 A	
Overload protection *)	5.5 A, 6.5 A, 7 A, 7.5 A, 8 A	
Tacho voltage *) (max 3000 rev)	3 V/1000 rpm 6 V/1000 rpm	3 V/1000 rpm preset on delivery
Resolver, ratio max speed	0,5 3000 rpm	
Setting range for position amplification KV	0,5 to 50, 1/s	See function parameters, Chapter 10.

*) Alternative connections and strappings for the control board YYT 102-, depending on which motor type is used, are shown in the system circuit diagram.

Connection axis 6:

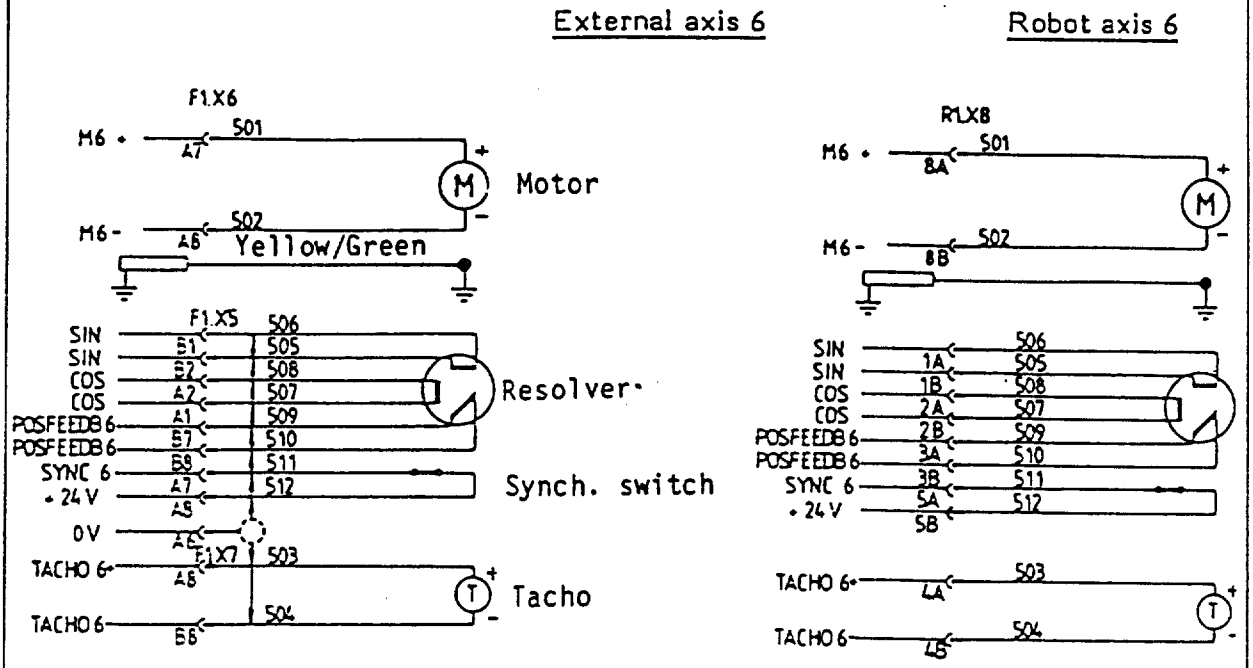


Figure 7-5

Connection axis 7:

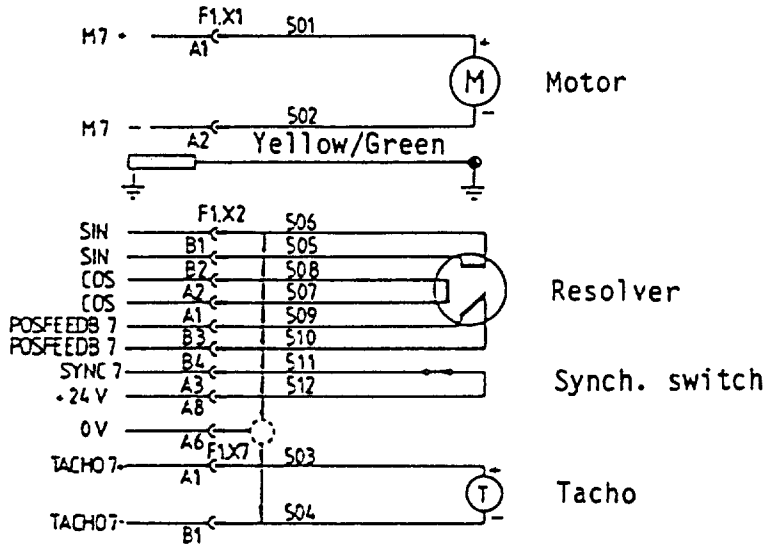


Figure 7-6

Connection axis 8:

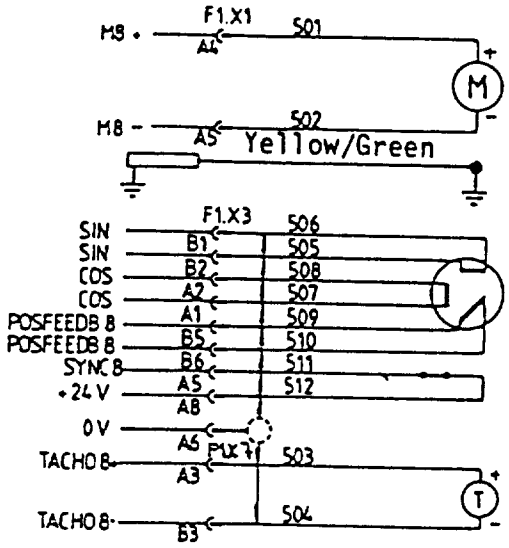


Figure 7-7

Connection axis 9:

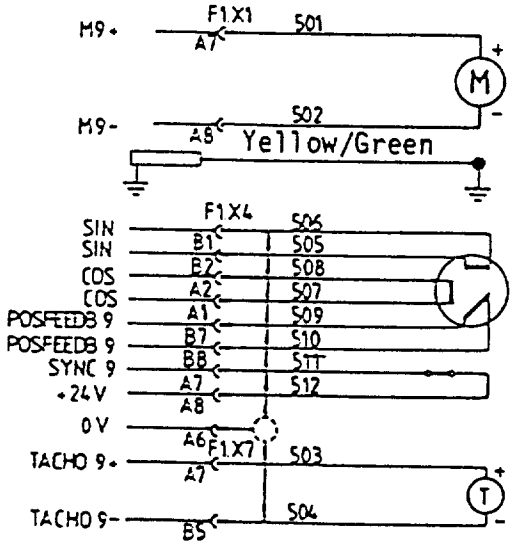


Figure 7-8

7.4
Third wrist motion

To increase the dexterity of an IRB 6/2 robot with 6 axes, it is possible to install a third wrist motion in two different ways as shown in the figure below. The robot is delivered installed in accordance with alternative 1 but can be easily changed to alternative 2. Change of the installation is described in a separate section below.

Alternative 1

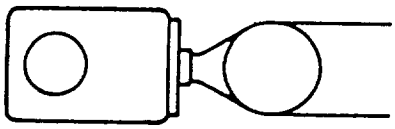


Figure 7-9

Alternative 2

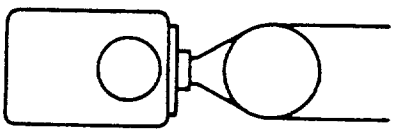


Figure 7-10

1. Remove protective cover (A) and unscrew the motor unit from the robot.
2. Rotate the cable gland (B) and withdraw the cable so that it extends over the motor unit.

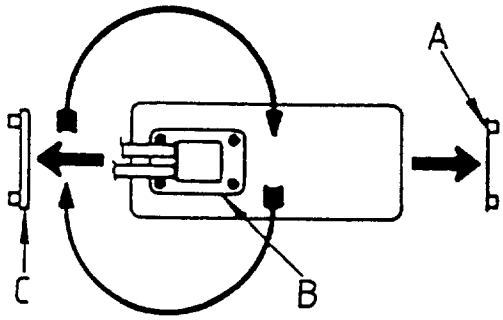


Figure 7-11

3. Screw the unit to the fixing plate in accordance with alternative 2 and fix at the same time the wiring on the fixing plate with a clamp and a cable strap via the holder in the fixing plate (C).

4. Screw the cover plate to the fixing plane.

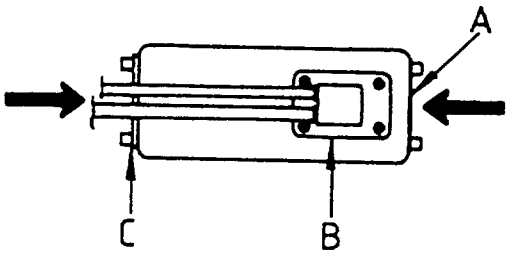
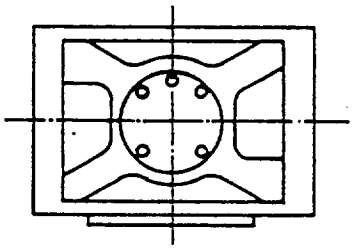


Figure 7-12

Ensure that the turning disc on the motor unit is correctly located in relation to the guide pin in the turn disc on the robot.



Guide pin

Turning disc of TWM

Figure 7-13

For the TCP position to be defined correctly in the control program, it is necessary to enter which of the alternatives is used as a value in the parameter memory. This applies also when the installation is used as delivered, i.e. Alternative 1.

8
MAINS VOLTAGE CONNECTION

Mains voltage is normally connected to terminal block F4.X1 at the left of the cabinet and the protective earth directly to the ground bar on the floor of the cabinet. The connection is made via the cable gland Ø 16 mm in the cover plate F1. If the cabinet is provided with a safety switch, the mains connection is made directly to this.

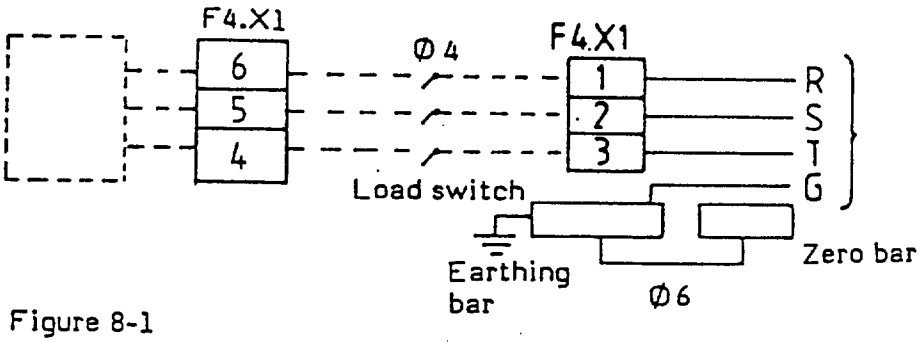


Figure 8-1

N.B. Connection in correct phase sequence is recommended.

See Chapter 4 for the recommended mains cable. Note that the conductors between terminal blocks and transformer are 4 mm^2.

The fuses on the primary side are to be installed outside the control cabinet. See the appropriate safety regulations.

Primary fuse: max 16 A
Rated power: 3,7 kVA (complete system)

The different units in the cabinet are grounded with green/yellow cable directly to the ground bar. It is also connected with a grey copper conductor, 6 mm^2 to the galvanically insulated zero-bar from the cabinet. The leads which serve as zeros or are used to improve the resistance of the cabinet to interference are connected with grey leads to the 0-bar or other suitable connection point in the cabinet.

The mains voltage and frequency for which the system is intended are specified on the rating plate on the control cabinet. The system is provided with one of four different transformers, depending on the voltage available.

Table 8-1

1	220 V	+10 % -15 %
2	380 V	+10 % -15 %
3	415 V 440 V 475 V	+10 % -15 %
4	500 V 525 V 600 V	+10 % -15 %

The system circuit diagram shows how alternative locations of jumpers are used for transformers in groups 3 and 4.

9
APPLICATION OF VOLTAGE AND START-UP

Reference: Programming Manual

Moment 1

Before switching on voltage, check that:

- The mains voltage available is correct (by measurement) and correctly connected, see chapter 8.
- The fuse on the primary side is installed correctly, see chapter 8.
- The necessary safety measures according to chapter 12 have been taken.

Moment 2

After voltage has been applied by means of the main switch on the control panel and the safety switch on the side of the control cabinet (if applicable), the following actions are to be taken in succession:

0. Check the positions of the toggle switches on the computer board, DSPC 153 pos D14.125 in the electronics rack. The upper switch is to be in its lowest position and the lower switch is to be in its mid position.

1. Check that the lamp "SYSTEM OFF" illuminates.

2. Press STANDBY and check that the cooling fans start and that the "STANDBY" and "SYSTEM OFF" lamps extinguish.

If the error lamp illuminates, continue to 3. Otherwise continue to 4.

3. Press SYSTEM OFF, connect the programming unit and press STANDBY.

If the system has been inactive for more than 1500 hours, the function parameters have been lost from the memory and language selection is presented. Each alternative is printed in its own language.

After the language selection, "PARAMETER MEMORY FAULT, RELOAD!" is presented on the programming unit display. See chapter 10, Function Parameters, for detailed information regarding this status.

4.1 Select the MANUAL menu (the button with an engraved hand) on the programming unit.

4.2 Depress the button at the extreme right of those immediately under the programming unit display.

4.3 Check then on the lower line of the programming unit display if a text with an asterisk is presented.

If such a text is presented, continue with point 4.4. Otherwise repeat the points 4.2 and 4.3 until the text with an asterisk appears.

4.4 Depress the button directly under the text with the asterisk.

4.5 Depress the button directly under the text printed in the required language.

5. Press RUN, check that the RUN lamp illuminates and that the STANDBY lamp extinguishes. The robot is now unsynchronized and the SYNC lamp is to flash.

6. Synchronize the robot by pressing SYNC on the control panel. The automatic synchronization of the robot then begins and the SYNC lamp illuminates steadily. If the programming unit is connected, this must be inserted in its compartment and the operation status AUTO is to be selected.

   When the synchronization is completed, the SYNC lamp extinguishes.

   The synchronization can be interrupted at any time with the stop button on the programming unit or on the control panel. The SYNC lamp should then resume flashing. The process can be resumed by pressing SYNC as before.

10
FUNCTION PARAMETERS AND SENSOR DATA

10.1
General

Reference: Programming Manual

Certain system-specific parameters are stored for the robot system as programmable function parameters.

The function parameters are normally determined when the robot system is installed by programming via the programming unit. The parameters are stored in a function parameter memory backed up by a battery (typical 1500 h). If the system has reserve voltage for memory back-up (see section 6.4.4), this includes the function parameter memory.

The following are stored in the function parameter memory:

1) Function parameters
2) TCP- and sensor data (see section 10.3)
3) Any displacement of the base co-ordinate system (see Programming Manual)

Data under points 2 and 3 are interpreted as program data and therefore need not be defined to obtain an operational system.

The normal values for the function parameters are stored in the fixed memory of the system (PROM).

The contents of the function parameter memory can be transferred to a floppy disk at any time (see section 10.2). This is always recommended if the contents vary from normal values. The programmer can then restart the system quickly in the event of an extended supply failure.

N.B! All handling of function parameters and sensor data requires that a programming unit is connected to the system.

After the entry of the function parameters is complete, the system is restarted which means that the robot must be synchronized and that all outputs and registers are cleared.

10.2
Entry of function parameters

This may be divided into two cases:

A. The function parameter memory has lost its information content after an extended voltage failure as normally happens when the system is installed.

B. Function parameters are entered but are to be amended, complemented or stored on a floppy disk.

Type case A:

1. Start the system as described in chapter 9.

2. Read, in status STANDBY, the text display on the programming unit. If language selection is presented on the lower display line and the error lamp indicates, proceed to point 3, otherwise see Type case B.

3. Four alternative languages are shown. Each alternative is printed in the language to be selected. One of these must be selected.

4. After the language has been selected, two alternative functions may be shown on the lower line of the display, DISK and PROM.

   One of these functions must be selected. All other modes are blocked.

   a) When the function DISK is selected, the function parameters are loaded into the system function parameter memory from a floppy disk.

      Action:

      Connect a floppy disk unit, insert a floppy disk containing the function parameters required and press the function button for DISK.

   b) If the function PROM is selected, normal values of the function parameters are transferred from the fixed memory (PROM) to the function parameter memory. Normal values are entered when the function button PROM is depressed.

5. Return to Chapter 9 or proceed to Type case B.

Type case B:

If the function parameters as described in Type case A, or function parameters entered previously are to be amended, supplemented or stored on a floppy disk, the following procedure is to be followed:

0. Press "STANDBY". If the robot system is prepared for computer link, proceed as follows. If not, continue to point 1.

   0.1 Press "MANUAL" pushbutton (with hand engraved on it) on the programming unit.

   0.2 Press the button below the display text "SCAN" and "leaf through" the menu until the text "RB MODE" is presented on the lower display line.

   0.3 Press the button below the text "RB MODE".

   0.4 Press the button below "LOCAL".

1. Press "MANUAL" pushbutton on the programming unit.

   1.2 Press the button below the text "SCAN".

   1.3 Press the button below "PARAM".

2. The system is then prepared for the following status.

   a) CHANGE
   The contents of the function parameter memory can be amended and new parameters can be added by programming. See section 10.2.1.

   b) FR DISK
   The contents of the function parameter memory can be changed by transferring new parameters from a floppy disk. Insert a floppy disk with the required function parameter in the floppy disk unit and press the function button FR DISK.

   c) TO DISK
   The contents of the function parameter memory are transferred to the floppy disk. This should always be done when the parameter deviate from the normal system values. Insert a formatted *) floppy disk in the floppy disk unit and press the function button TO DISK.

*) The floppy disk must be formatted if it is new. This is performed as follows: Press control button MAN. Access the function FORM FS with SCAN and press the function button. Formatting takes approximately 30 seconds.

10.2.1
Amendment of function parameters

When the function CHANGE has been activated (see Type case B) the function parameters to be changed or added to the function parameter memory can be programmed in.

The parameters to be changed are selected individually in the basic menu of which the first part is shown on the lower line of the programming unit when CHANGE is selected. A parameter group or individual parameter is selected as follows:

1. Search in the lower line of the programming unit for the text which corresponds to the parameter required. If the required text is not shown, call up the next part of the menu with the button at the extreme right immediately under the display (SCAN) and search for the text again. Repeat this until the required text is presented.
2. Press the button immediately under the text required.

When a parameter is selected incorrectly, the following procedure should be follows:

1. Search for the function BREAK. If this is not shown, press the button below the text "ENTER" and search for "BREAK" again. Repeat this until "BREAK" is presented on the display.
2. Press the button below the text BREAK.

This returns the system to the basic menu.

All values within a parameter must always be checked, irrespective of values to be changed, before a return can be made to the main menu for the group. The following applies for the checking:

- Current values are presented on the upper line of the display.
- If the current value is to be changed, "type" the new value on the numerical button set and then press ENTER. If incorrect values are typed before the ENTER button is pressed, press CE, type new figures and press ENTER.
- If the current value is not to be changed, press ENTER directly.

When the parameter values have been checked, press BREAK to return to the basic menu. Select a new parameter group or individual parameter to be changed.

Finally, when all of the required parameter changes have been made, select the ACTIVE function to exit from the parameter menu.

The function parameters which can be defined, and the range of permissible values, are given in the following table.

From the table, it can also be seen which normal values are selected by the system if the parameters are supplied from the fixed memory of the system with the function PROM. See section 10.2, type case A.

Table 10-1 Modification of function parameters.

Function parameters	Alternative	Normal value	Notes
KEY Blocking of the programming unit functions with the key on the control panel	KEY = 0 KEY = 1	KEY = 0	Menu: KEY Programming not possible The complete progr. unit
SYNC POS NO Selection of synchronizing position for the 1:st (C) axis.	SYNC POS NO = 0 4) = 1 4) = 2 4)	SYNC POS NO = 0	Menu: SYNC See Fig. 10-2.
MOUNTING TWM (Shown only if the robot has 6 axes.	The motor unit is installed against the robot turn disc with: 1 = Short side and hollow shaft outwards. 2 = Short side and hollow shaft inwards.	Alternative 1	Menu: AXIS + ROBOT + TWM See section 7.4
WORK AREA ROBOT AXES Working range for robot axes	A1- = -180 - 0 A1+ = +180 - 0 A2- = -40 - 0 A2+ = +40 - 0 A3- = -25 - 0 A3+ = +40 - 0 A4- = -90 - 0 A4+ = +(90 - 77) *) A5- = -(180 - 42) *) A5+ = +180 - 0 A6- = -150 - 0 A6+ = +210 - 0	A1- = -180 A1+ = +180 A2- = -40 A2+ = +40 A3- = -25 A3+ = +40 A4- = -90 A4+ = +90 A5- = -180 A5+ = +180 A6- = -150 A6+ = +210	Menu: AXIS + ROBOT (+ WORK A) Working ranges are shown in Fig's. 10-4 and 10-5. *) The working range must contain the sync position.

Function parameters	Alternative	Normal value	Notes
WORK AREA EXTERNAL AXES Working range for external axis	A6- = y A6+ = y A7- = y A7+ = y A8- = y A8+ = y A9- = y A9+ = y	No external axes (A7- to A9+) = (-2147483648)	Menu: AXIS + EXTAX The value "y" specifies number of increments 1) 1 increment = $\frac{1}{640}$ resolver rev. Definition range $-2^{31} \leq y \leq 2^{31}$ Resolution 1
TIME Time limit on the instruction conditional WAIT with the optional time supervision	TIME = y	60 s	Menu: TIME The value "y" indicates the max waiting time in secs. Definition range $0 \leq y \leq 320$ s Resolution 1 s
AXIS BRAKE Holding brake on axes	A1 = 0 or 1 A2 = A3 = A4 = A5 = A6 = A7 = A8 = A9 =	A1-A9 = 0	Menu: AXIS + BRAKE A1 to A9 gives axis 1-9 2) 0 = without holding brake 1 = with holding brake
KV Entry of position gain amplification K_V for external axes. 5)	A7 = y) A8 = y A9 = y	Deactivated regulator (-1)	Menu: AXIS + EXTAX Definition range KV = 0,5 x x ($2 \leq y \leq 100$), 1/s Resolution 1
I/O TYPE Type and location of extra input/ output board	IO 165 = y IO 169 = y IO 173 = y IO 177 = y	Not equipped (0)	Menu: IN/OUT + IN/OUT The value y specifies the type of board 3) 1 = DSDX 110 2 = DSDO 110 4 = DSDO 131 6 = DSDI 110 8 = DSDI 130 10 = DSAI 120 11 = DSAO 110

Function parameters	Alternative	Normal value	Notes
SOFT SERVO Soft position control of one or more robot axes	Yes = 1 No = 0	No soft servo (0)	Menu: SOFT S Requires control board YYT 102H 6)
COMM BOARD Serial communication board for computer link and program printout	Yes = 1 No = 0	No board (0)	Menu: IN/OUT + COMM
BAUD RATE CH 0 Transmission speed on channel 0 with program printout.	1 = 1200 baud 0 = 300 baud	300 baud	Menu: IN/OUT + COMM
IRB IDENTITY Selection of robot identity in relation to superior computer with computer link	IRB IDENTITY = Y	Identity not specified (0)	Menu: CLINK The value y can be 0-127
ACTIVE Selection of the function parameters which have been defined or changed after the system delivery, now or earlier.			Menu: ACTIVE
PROM Selection of the function parameters stored in the PROM on the system delivery			Menu: PROM
MONITOR BOARD Board intended for use with the optional monitor	Present = 1 Not present = 0	No board (0)	Menu: IN/OUT + MONITOR

Function parameters	Alternative	Normal value	Notes
0-ZONE (mm) Selection of zero-zone size	SMALL = A LARGE = B EXLARGE = C COARSE = X	See table below 7)	Menu: 0-ZONE A, B, C and X can be 1 - 300 mm 7) Resolution: 1 mm
UNIT Selection of European or American units for programming unit communication	0 = European units (mm, mm/s and kg) 1 = American units (inch, inch/min. and pound)		Menu: INCH/MM
AMS (for IRB L6 and IRB G6 with 5 axes only)	1 = Absolute measuring servo system. 0 = Servo system with sync. switches	Servo system with sync. switches (0)	Menu: OPTION The parameter value must correspond to the servo system of the robot system.
VISION (for IRB 6 and IRB L6 only)	1 = Robot system equipped with Vision functions. 0 = Robot system not equipped with Vision functions.	Without Vision functions (0)	Menu: OPTION The value 1 requires a robot system with Vision equipment. Cannot be combined with gluing functions (the (GLUE parameter must be set to 0)
GLUE	1 = Robot system equipped with gluing functions. 0 = Robot system not equipped with gluing functions.	Without gluing functions (0)	Menu: OPTION The value 1 requires a robot system with gluing equipment (...6 GL)
MEMORY	1 = 32 kword 0 = 8 kword	8 kword (0)	Menu: MEMORY 8)

PARAMETERS FOR IRB L6AW/2 and G6AW/2 ONLY:

Function parameters	Alternative	Normal value	Notes
VOLTAGE PORT			Menu: VOLT + PORT
Port number for voltage reference signal	21 - 26	25	
1. PARAM MIN (V)			Menu: VOLT + VALUE
Minimum welding voltage.	Def. range: 0-100 V Resolution: 0.1 V	0	
2. PARAM MAX (V)			
Maximum welding voltage.	Def. range: 0-100 V Resolution: 0.1 V	100	
3. REF MIN (V)			
Minimum value for voltage reference	Def. range: -10 - +10 Resolution: 0.1 V	0	
4. REF MAX (V)			
Maximum value for voltage reference	Def. range: -10 - +10 Resolution: 0.1 V	0	
CURRENT PORT			Menu: CURR + PORT
Port number for current reference signal	21 - 26	26	
1. PARAM MIN (A)			Menu: CURR + VALUE
Minimum welding current	Def. range: 0-1000 A Resolution: 0.1 A	0	
2. PARAM MAX (A)			
Maximum welding current	Def. range: 0-1000 A Resolution: 0.1 A	1000	
3. REF MIN (A)			
Minimum value for current reference	Def. range: -10 - +10 Resolution: 0.1 A	0	
4. REF MAX (A)			
Maximum value for current reference	Def. range: -10 - +10 Resolution: 0.1 A	0	

PARAMETERS FOR IRB L6AW/2 and G6AW/2 ONLY: (cont'd.)

Function parameters	Alternative	Normal value	Notes
1. TYPE OF MOTION			Menu: AXES + EXTAX
Linear or rotating external axis.	LIN. or ROT.		
2. GEAR RATIO LOW	Def. range: 0 - 65535 Resolution: 1		
Gear ratio for motor axis.	Value 0 means gear ratio not defined.		
3. GEAR RATIO HIGH	Def. range: 0 - 65535 Resolution: 1		
Gear ratio for outgoing axis.			
COMMON DRIVE UNIT			Menu: AXES + COMMON
Common drive unit for two external axes (6-8 resp. 7-9).	1 = Present 0 = Not present	Not present (0)	

1) The working range is defined for positive or negative direction from the synchronizing position, see Figure 7-4.

2) The axes of the robot are numbered as shown in Figure 10-1, the external axes are numbered as given in section 7-3. IRB 6/2 normally has no brakes on the robot axes.

WARNING! a) If an axis without brake is defined with brake (=1), the robot can collapse when the stop position is reached.

b) If an axis with brake is defined without brake (=0), the brakes can be worn out or the robot may go to an emergency stop as the servo system attempts to compensate for the position of the axis against locked brakes when the stop position is reached.

3) The numbers 165-177 define the different board places in the rack D14 as defined in section 6.2.3.

4) To permit the use of SYNC POS NR 1 or 2, the internal bar for screening the sync. switch of the first axis must be replaced with bar 2171 409-32.
For adjustment of SYNC POS 1 or 2, see the Service Manual.

5) See section 7.3, External axes.

6) Replaces control board YYT 102 A-F for the robot axes concerned.

7) The values in the table below are valid for movement of the first axis with TCP 0 and maximum reach.

IRB *)		A	B	C	X
6/2	5-axes	1	7	50	Not defined
6/2	6-axes	1	7	"	"
L6/2	5-axes	1	8	"	"
L6/2	6-axes	1	8	"	"
G6/2	5-axes	1	7	"	"
G6/2	6-axes	1	7	"	"

8) Gluing IRB 6 robots are all equipped with two memory boards. To make full use of these, this parameter is to be set to 1.

*) Values for e.g. L6/2 are also valid for special version robots, e.g. L6 GL/2.

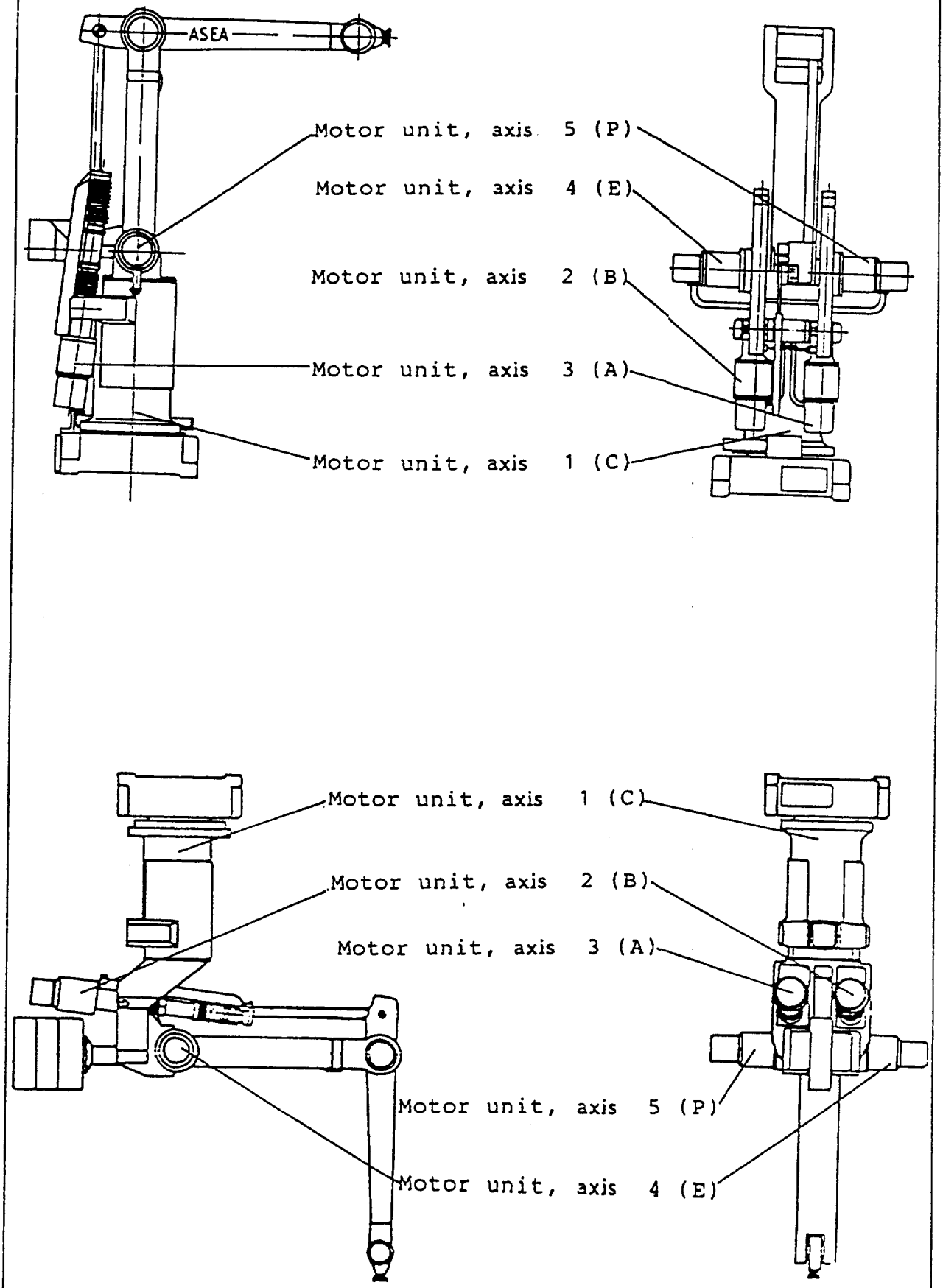


Figure 10-1 Axis numbers and designations

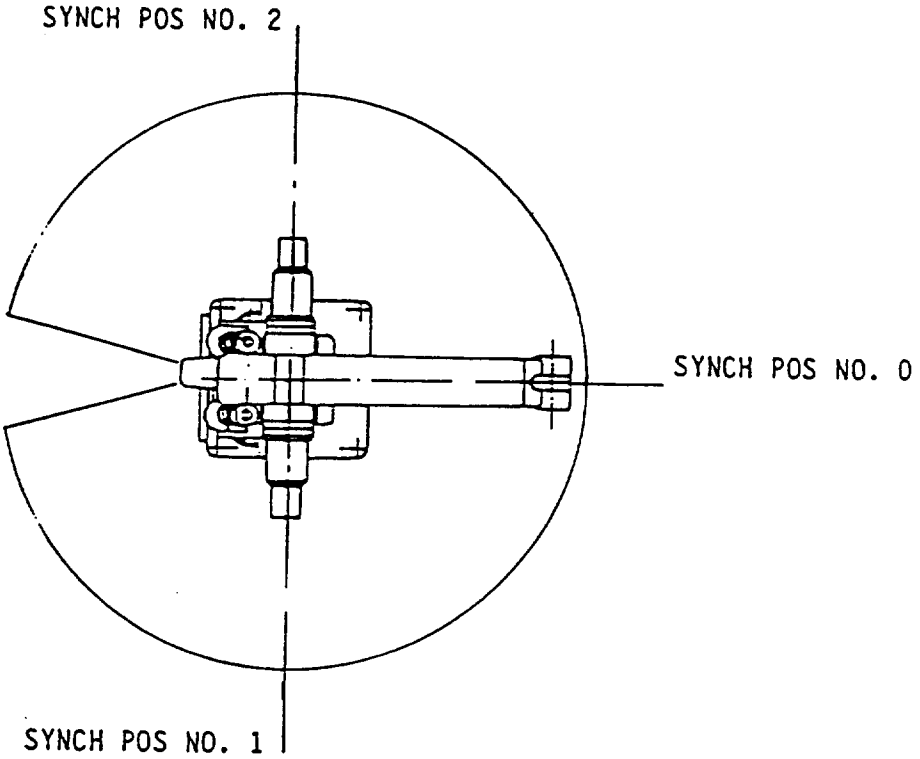


Figure 10-2 Alternative sync. positions of axis 1 (C), for both IRB L6/2 and IRB G6/2

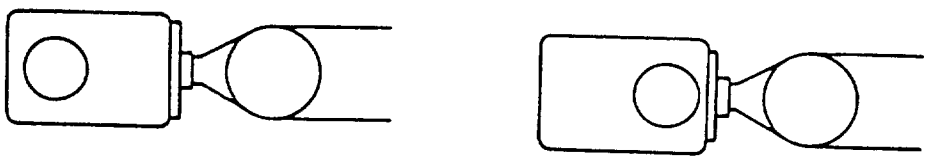


Figure 10-3 Sync. position of Third Wrist Motion

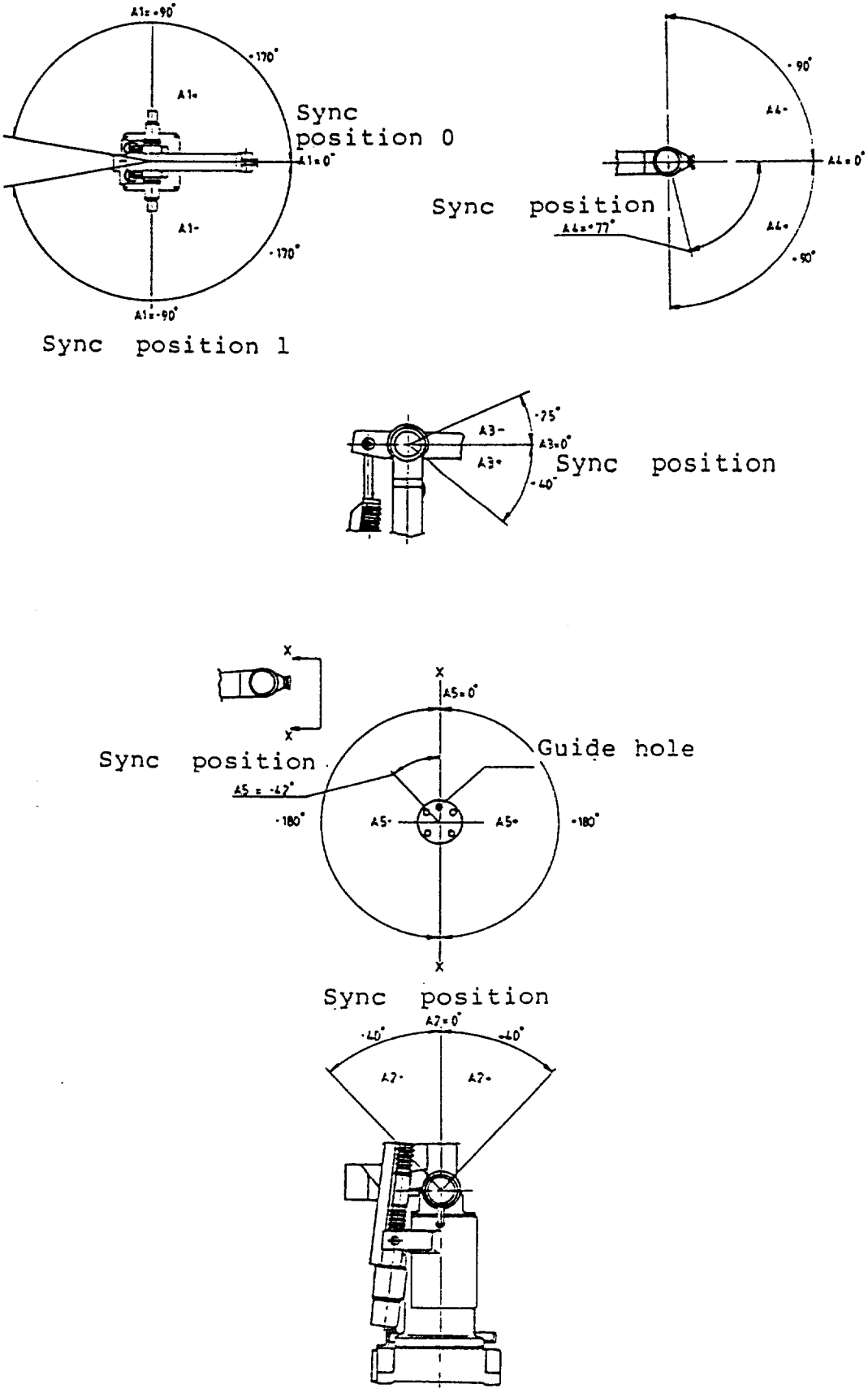


Figure 10-4 Sync. positions and working range, IRB L6/2

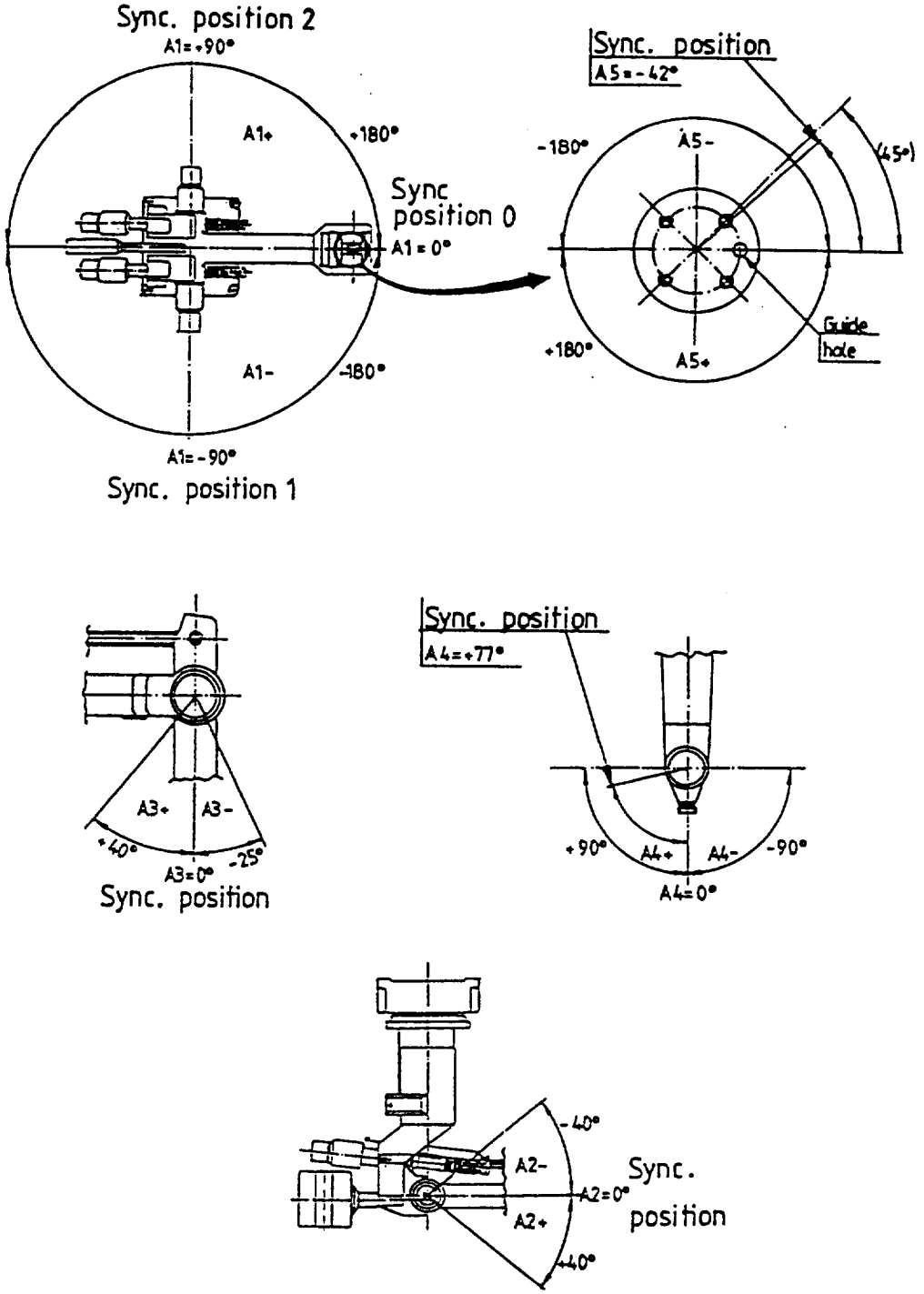


Figure 10-4 Sync. positions and working range, IRB G6/2

10.3
TCP- and sensor data

The positions of working points (TCP) and sensor data can be defined under the function TOOL. This data is stored in the function parameter memory.

For definition of TCP, see Programming Manual.

10.3.1
Entry of sensor data

For connection of sensors, see section 7.2.

Access status SENSOR by activating:
1 a Control button MAN
  b Function button SCAN
  c Function button SENSOR

The system is now prepared for entry of sensor data.

2 The following text will be presented on the programming unit display:

SENSOR NR = CE ENTER

3 Enter sensor numbers 1 to 16 (7) and give the command ENTER.

S7

NUMBER OF BITS = CE ENTER

If S7 is already defined, all information about the sensor is presented:

S7 R 8B INP77 S: 1,0 -100/100

NUMBER OF BITS = CE ENTER

Two alternatives are available:
ALREADY DEFINED
and UNDEFINED sensor.

A) If the sensor is not defined: go further to point 4.
B) If the sensor is defined: see point 10.

4 Alternative A, undefined sensor

Write the number of bits 0 to 8 (6) and give the command ENTER.

0 bits means analog sensor.
1 to 8 bits means digital sensor

S7 6B

INPUT NO = CE ENTER

For a digital sensor with three or more bits, the most significant bit (MSB) is the sign bit.

5 Write the input number for the least significant bit (LSB) (62) and give the command ENTER.

S7 6B INP62

MOUNTED ON ROBOT YES NO

6 State if the sensor is installed on the robot or not. If "yes", the correction depends on the position of the robot hand. If "no", there is no correction.

S7 R 6B INP62

SCALE: CE ENTER

7 Write in the gain factor 0 to 99.99 (1.0) (sensor reading mm/binary value) and give the command ENTER.

If the sensor is of the ON/OFF or TWO-BIT type, the sensor entry is concluded with the question:

S7 R 6B INP62 1,0

MORE SENSORS? YES NO

If the answer is YES a restart begins at point 3.
The answer NO gives a return to point 1 a) above.

If the sensor has 0 bits or more than 2 bits, the following is presented:

S7 R 6B INP62 1,0

MIN VALUE = CE ENTER

8 Write in the minimum permitted digital value from the sensor and give the command ENTER.

S7 R 6B	INP62	: 1,0	-10/
MAX VALUE =	CE	ENTER	

The max. value can be within the interval $+/-2^{n-1}$ where n is the number of bits in the sensor. For an analog sensor, a sensor signal of +/-10 V corresponds to +/-10 bits, i.e. n = 11. See Analog Inputs, section 6.3.

9 Write in the max. permitted digital value from the sensor and give the command ENTER.

S7 R 6B	INP62	1,0	-10/15
MORE SENSORS?	YES	NO	

The answer gives a restart from point 3 or point 1, respectively.

10 Alternative B, sensor defined already

The same sequence is run through. If the command ENTER is given without data entered, this is interpreted as meaning that the previous values are considered to apply. If the number of bits is changed, the MAX. and MIN. limits are erased.

11
RUNNING THE ROBOT

Reference: Programming manual

Check of working range

Start the robot system with the power switch, "STANDBY" pushbutton and "RUN" pushbutton, according to chapter 9.

Synchronize and check that the robot is in the synchronizing position.

Run the robot manually with the joystick and check that motion in both directions in the x-, y- och z- directions is possible, and that the extreme positions can be reached.

Check of operation functions

Program a simple movement pattern with a number of fine and coarse points and check that the program is executed correctly by stepping with function button INSTR ST and with VELOCITY approximately 200 mm/s.

Press AUTO and check that the lamp AUTO illuminates and that the program is executed correctly in operation mode AUTO.

If the control equipment is provided with a floppy disk unit this is checked by reading the program on to a floppy disk and then loading this back to the memory. Check that the program is correct by running the robot in operational mode AUTO.

12
SAFETY PRECAUTIONS

12.1
General

The industrial robot is a practical and versatile aid in different kinds of production. With respect to personnel safety the robot must be treated with at least the same respect as other machines and tools.
Observe that:

- The range of robot movements is often larger than the range in which it normally works.
- Even slow robot motions are performed with considerable force.
- The robot can be programmed to give an irregular movement pattern including pauses, rapid accelerations and braking.

12.2
Personnel safety

12.2.1
Integrated functions

- Emergency stop buttons on control cabinet and programming unit.
- (For DSQC 124 only:) When a fault occurs in any of the emergency stop relays, the robot system will switch into emergency stop.
- Safety pad to prevent unintentional robot movement during programming and synchronization with the joystick.
- Limitation of positioning speed with programmed running if the programming unit is connected and removed from its compartment.
- Start of programmed running from the cabinet impossible if the programming unit is connected and removed from its compartment.
- (For DSQC 124 only:) Program execution is possible only when a plug is connected to the outlet for the programming unit on the control cubicle. The plug can alternatively be:
  * The one on the programming unit.
  * The blind plug, situated beside the outlet.
- Overspeed supervision.
- Resolver supervision.
- Connection terminals for coordination of the emergency stop systems of the robot and the peripheral equipment.

12.2.2
Dead man's handle (option)

The use of the dead man's handle and workstop increases the personnel safety when programming the robot within the robot risk zone. The workstop alone can be used, for example, when it is necessary to enter the risk zone for servicing or some other action. From the point of view of personnel safety the workstop operates in the same way as the emergency stop function but it is not connected with the emergency stop loop. The function of the dead man's handle is described in chapter 6.

12.2.3
Safety procedures during installation

Follow the following procedures when installing a robot system, to minimize the risk of injury to personnel.

a) Surround the working range of the robot with a guard rail and install gates with limit switches connected in series with the emergency stop circuit to stop the robot and other external equipment when a gate is opened (see section 6.4.3).

b) Locate extra emergency stops at suitable places. Connect all of the emergency stops in series so that both robot and peripheral equipment stop when any optional emergency stop is tripped (see section 6.4.3)

c) If the guard rail around the robot enters the robot working range anywhere, ensure that this area is protected. Stretch a line as a trip wire or install a tramp-mat and connect this to a contact to trip the emergency stop (see section 6.4.3). Remember that the robot requires a certain braking distance.

d) If an operator is to serve the robot manually, ensure that the robot cannot move before the operator has removed his hands. Use, for example, a photocell to control a programmed WAIT function via a digital input to the control system (see Programming Manual).

N.B. For a) and d) workstop can also be used when provided, see preceding section.

12.2.4
Procedures during operations

When running or programming the robot system, always obey the following instructions:

- Ensure that no person is inside the guard rail and remain on the outside yourself.

- If it is essential to go in to the robot:

  a) Stop programmed running!
  b) If the robot is not to run, switch to the Stand By mode.
  c) Take the programming unit with you, if such is connected.
  d) If possible, have an assistant located outside the guard rail, prepared to stop the equipment in the event of accident.
  e) Be prepared for your own mistakes during work inside the guard rail.

12.3
Operational safety

12.3.1
Integrated supervision functions

The following supervision functions are built into the system:

- Automatic emergency stop if the robot stalls, or any software or hardware faults, for instance fault in program memory, control program or breakage of a resolver conductor.

- Immediate error print-out in plain language following operation or system error.

12.3.2
Procedures at installation

For the robot system to operate satisfactorily:

- Ensure that the environmental requirements of the robot system are satisfied, particularly when a floppy disk unit is to be used constantly (see Chapter 3).

- Read in all function parameters and remember particularly data for any sensors or external axes (see Chapter 10).

- Test the system properly. Check particularly the battery back-up of the robot memory and the floppy disk unit if used.

- Make use of all possibilities of supervising the robot system operation.

  Remember in particular that an alarm should be generated if the mains voltage to the system fails and utilize if possible, the ERROR output for alarm and the direct inputs for jump to subprogram 1-5 (see section 6.2.3).

12.3.3 Procedure when operating

Remember the following when operating the robot to ensure maximum operational safety:

- Include supervision of the robot operation in all programs when malfunction can cause injury to personnel or damage to the robot or its peripheral equipment.

- Never neglect the service and maintenance specified and ensure that the recommended set of spare parts is always readily available.

- Operate the complete robot system with care and judgement.

Finally:

Always ensure at start-up that:

- The robot installation is undamaged.

- No person or irrelevant object is within the working range of the robot.

13
CONNECTION, DISCONNECTION OF RTXG CONNECTORS

RTXG-connector with single or double terminals.

The connector consists of a socket section with built in locking clips and a pin section with integral pins and contact clips. It is convenient to screw the pin section to an apparatus frame. The socket section is plugged into the pin section and locked in place with a locking screw, see Figure 13-1. Conductors with areas from 0.25 mm^2 to 1.5 mm^2 can be used in both pin and socket sections.

Keying pins are provided in the pin section to prevent insertion of an incorrect socket section in the pin section.

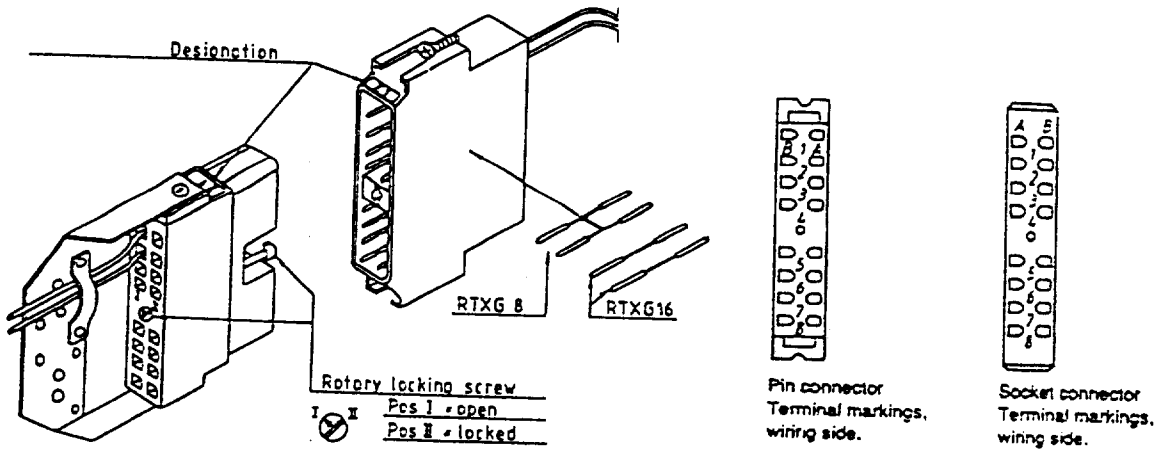


Figure 13-1

RTXG-connector with single terminal (16) is designated as:

RTXG 16-1	for pin section
RTXG 16-0	for socket section

RTXG-connector with double terminal (8) is designated as:

RTXG 8-1	for pin section
RTXG 8-0	for socket section

4 RECOMMENDED CABLE TYPES

All mains voltage and signal cables in the cabinet should remain unaffected at 70 °C.

Mains voltage cable

The mains voltage wiring is to be a class 4 insulated three conductor cable plus protective earth lead. It must satisfy the requirements of the relevant authorities in the country in which it is installed. The connection to the terminal block in the control cabinet permits the use of conductors with area up to 6 mm^2.

Signal cables

Measurement transducer signals for external axes and analog signals are to be connected with screened 2-conductor or multi-conductor cables.

Signals for digital inputs/outputs, emergency stop etc. should be screened, particularly when routed near wiring generating considerable interference.

The signal cables are to be of class 4 with conductor areas greater than 0.25 mm^2. The maximum conductor area for terminal block connections is 2.5 mm^2 and for RTXG-contact connections is 1.5 mm^2.

Table 4-1

Recommended cables:

Type	Number of conductors	Conductor area	External diameter	Screen	Cat. No.	Recommended function
RDO-S	4	2.50	11.0	-	1686 0022 -31	Mains voltage
"	4	4.00	13.0	-	-32	"-
RKFR-1	3 x 2	0.25	7.5	Yes	1686 0062 -1	Signal cable
"	6 x 2	"	9.5	Yes	-2	"-
"	10 x 2	"	11.2	Yes	-3	"-
"	18 x 2	"	14.0	Yes	-4	"-
REV	5	1.50	13.0	-	1686 0039 -01	Motor cable

5
INTERFERENCE SUPPRESSION

5.1
General

The wiring should be divided into groups to separate the wiring generating interference (a) from that sensitive to interference (b).

a) Operating signals > 60 V

Power and motor signals

b) Operating signals < 60 V

Measurement transducer signals, digital signals, etc. The cables should not be routed parallel with less separation than 30 cm and are not to be routed together with other interference generating cables. Certain measurement transducer signals are to be provided with a screened conductor as described in Chapter 4.

5.2
Interference protection

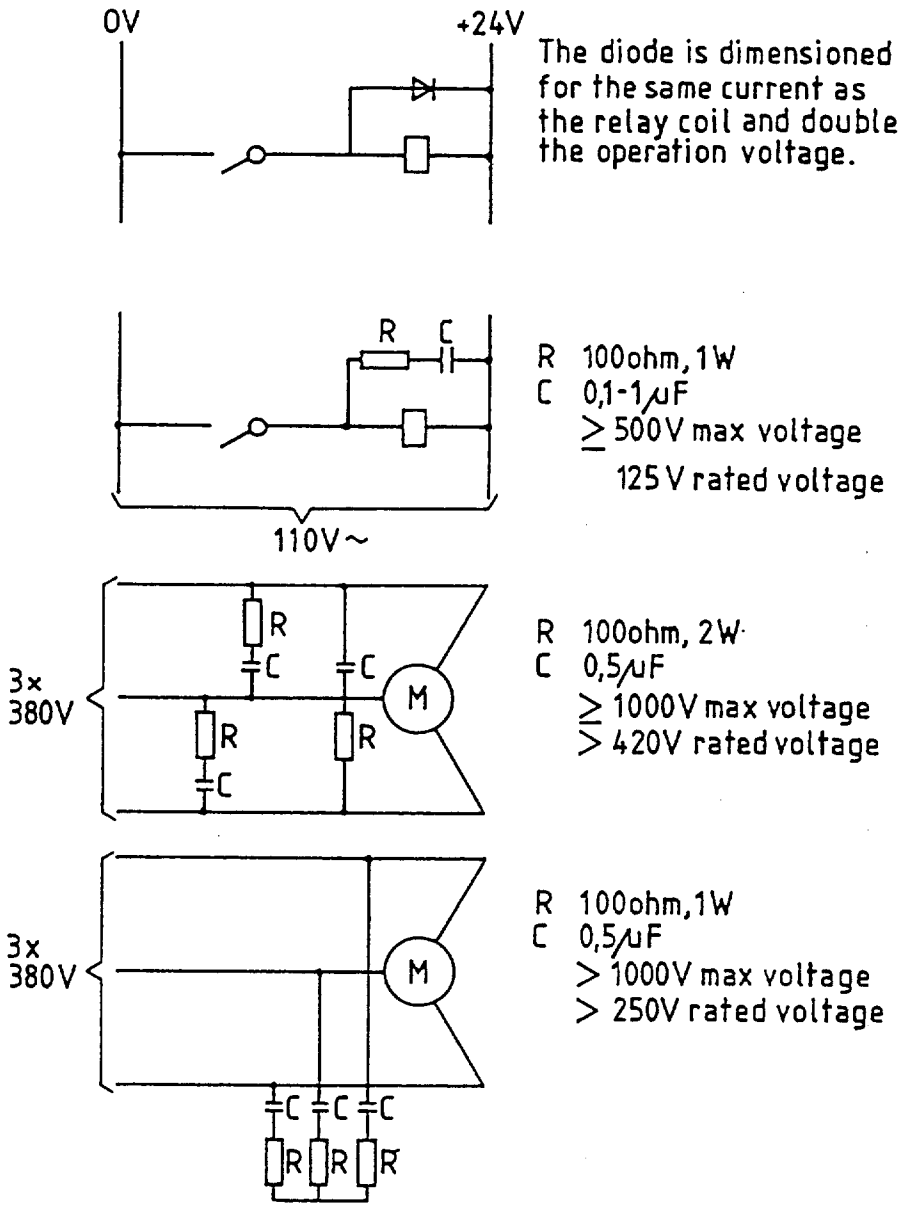
Relay coils and other elements of the control system are suppressed so that their operation does not cause interference in the electronics.

Relay coils, solenoid coils and motors outside the cabinet should be suppressed in a corresponding manner. Figure 5-1 illustrates examples of this.

Note that the switch-off time of a relay increases when a diode is connected over the coil.

Diodes and RC-filters can be replaced with metal oxide varistors.

Suppression of coils also increases the service life of the contacts which control the coils.



Interference protection

Figure 5-1

6
CONNECTIONS AND SIGNAL DESCRIPTION

6.1
Connections and routing of cables

6.1.1
General

The programming unit is connected to a plug in its compartment in the control cabinet (or in an external compartment if provided). The floppy disk unit is inserted into its compartment and fixed with screws.

At the lower left (or right, if requested) side of the control cabinet, two outputs F1 and F2 are provided for external wiring. See Figure 6-1.

The control cable to the mechanical robot and the cables for the external control panel and programming unit compartment (when appropriate) are connected to F2 via cable glands.

A cover plate is fixed at F1 for the passage through cable glands of other cables including the mains connections. See section 6.1.3

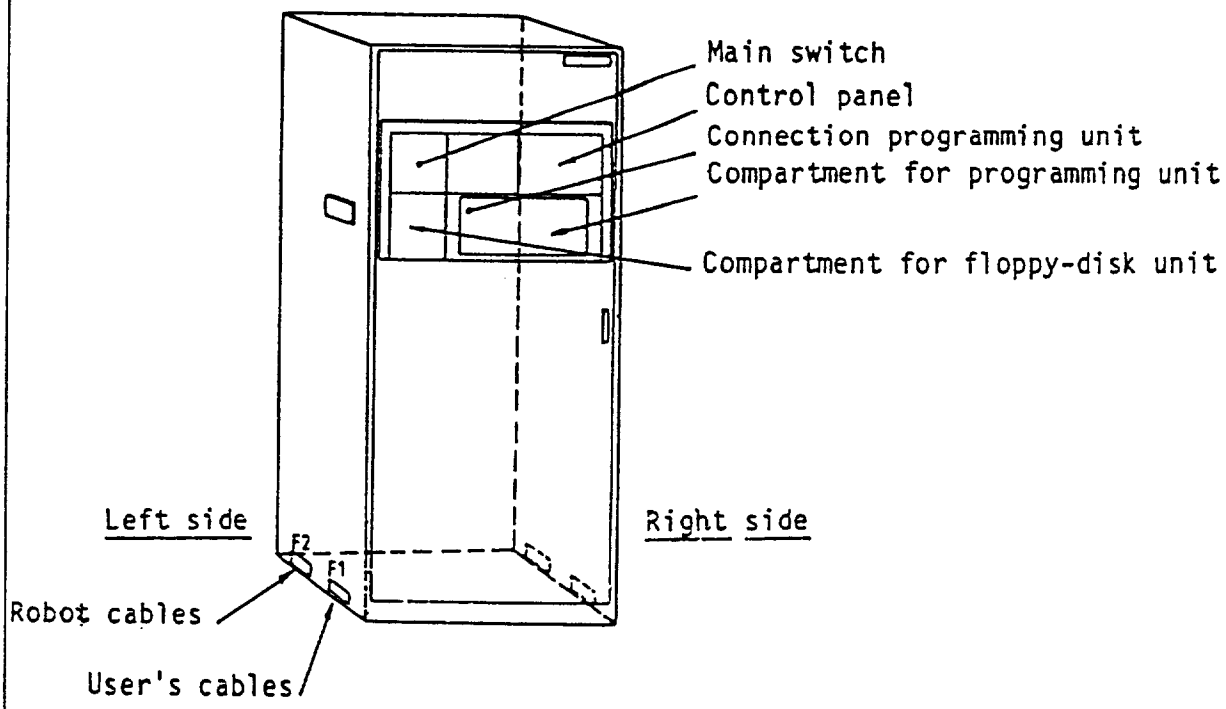


Figure 6-1

The cables are connected to terminal blocks in the control cabinet with the exception of those for robot control, external axes, external control panel and the programming unit compartment for which RTXG contacts are used. See Chapter 13 for connections to RTXG contacts.

The locations of the terminal blocks and RTXG contacts are indicated on the inside of the door. See also Figure 6-2.

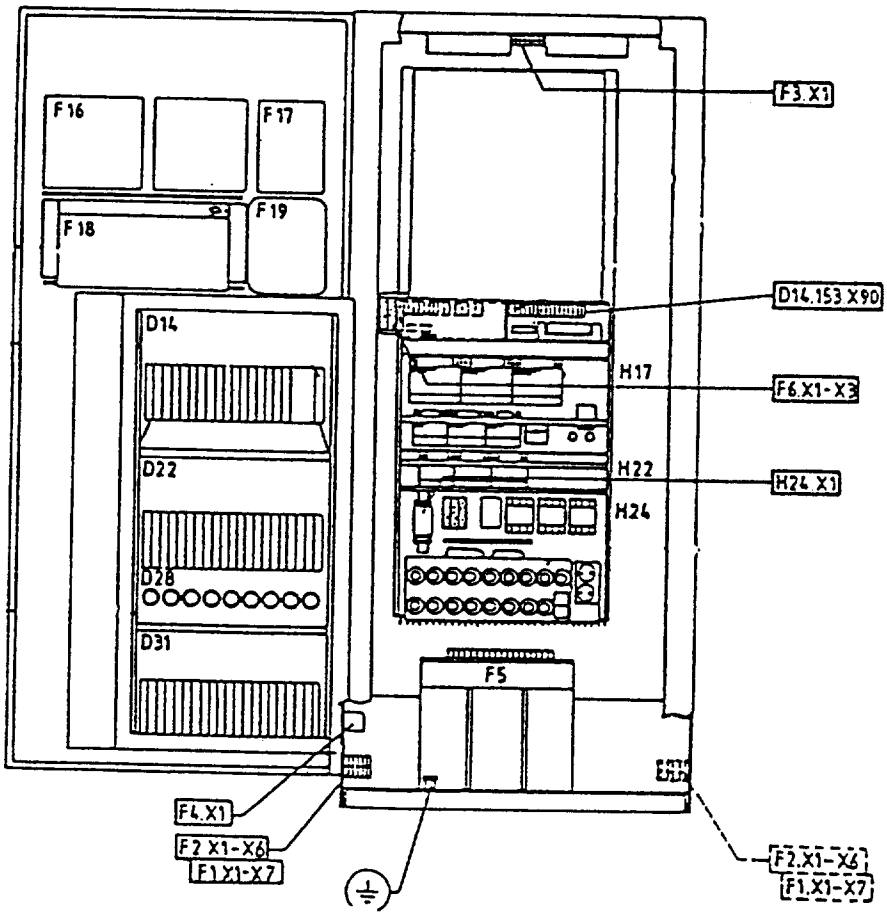


Figure 6-2

The control cable is connected at the base of the robot as shown in Figure 6-3. All connections to the mechanical robot, including customer connections, are transmitted via the control cables from the control cabinet.

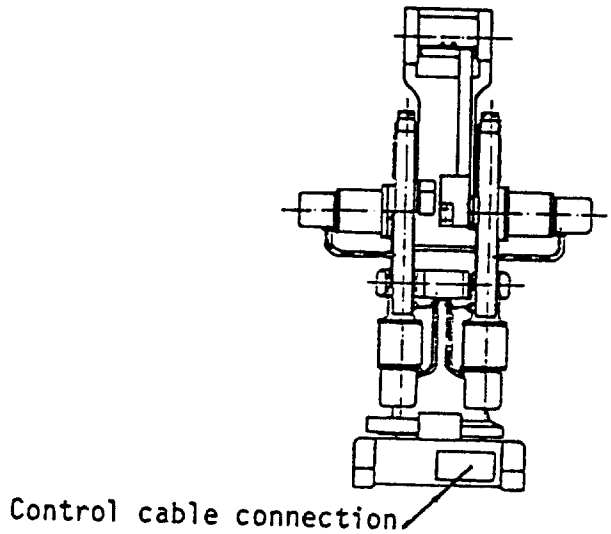


Figure 6-3

The following units are delivered with cables for direct connection to the control system:

1) Mechanical robot
2) External axes *)
3) External control panel *)
4) External programming unit compartment *)
5) Programming unit *)

*) When this equipment is included in the system.

6.1.2 Cable routing

Cables from the exterior are to be fixed in the cable duct at the right of the cabinet. Cables which must be drawn to the opposite side of the cabinet are routed on the floor in front of the transformer. A cable duct is located on the under side of the power unit (H24) for connections to this (see Figure 6-4).

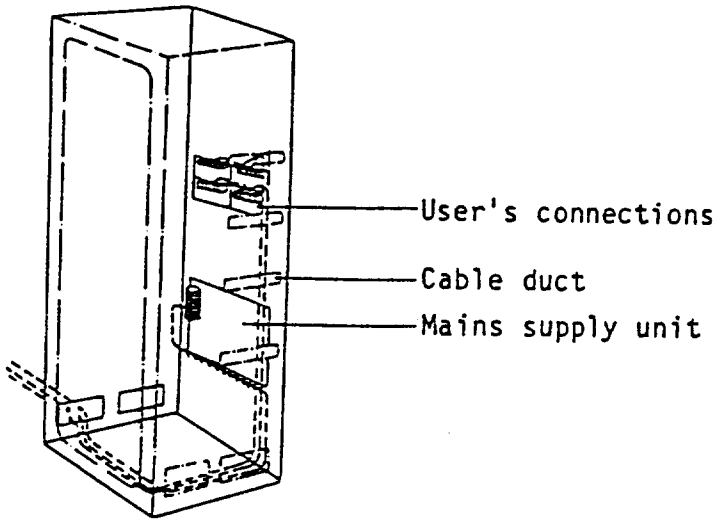


Figure 6-4

When installing cables, the recommendations for interference protection as described in chapter 5 are to be followed.

Note that the external wiring may not be routed in the cable duct at the left of the cabinet together with the internal wiring.

6.1.3 Cable glands

The external cables are to be connected via cable glands on the cover plates at F1 and F2.

It is important that the cable glands are tight to prevent dust entering the control cabinet.

The following cable glands are available:

Cover plate F1:	3 of Ø 16 mm (14.5-17.5 mm) 1 of Ø 24 mm (22-25.5 mm)	Mains connections Safety switch External axis Other cables
Cover plate F2:	2 of Ø 16 mm (14.5-17.5 mm)	External programming unit compartment External control panel

6.2
Digital inputs/outputs

The three main types of robots; basic, arc welding and gluing robots, differ somewhat in the I/O-board equipment and the connections of these inputs/outputs. Chapter 14 deals with arc welding and chapter 15 with gluing functions. The basic functions can be found in the remaining chapters.

Basic robot

- 1 basic digital I/O-board + up to 4 optional boards including max. 1 analog output board, and max. 2 analog input boards.
- Digital outputs 1-6 and inputs 1-7 available for customer's use.
- 4 optional analog outputs, and up to 32 optional analog inputs.

Arc welding robot

- 2 basic digital I/O-boards + up to 3 optional boards including max. 1 analog output board, and max. 2 analog input boards.
- Digital outputs 7-9 and inputs 6-10 used for arc welding purposes. Digital outputs 1-6 and 10-13, and digital inputs 1-5 available for customer's use.
- Digital outputs 14-15 and inputs 11-14 can be used to enable required external axis of those controlled by a common drive unit.
- 2 analog outputs on resolver supply board + 4 optional analog outputs, and up to 32 optional analog inputs.

Gluing robot

- 2 basic digital I/O-boards + up to 3 optional boards including max. 1 analog output board, and max. 2 analog input boards.
- Digital outputs 1-11 and inputs 1-5 used for gluing purposes. Digital outputs 12-15, and digital inputs 6-7 available for customer's use.
- 2 analog outputs on resolver supply board + 4 optional analog outputs, and up to 32 optional analog inputs.

6.2.1 General

The control system contains a basic set of digital inputs/outputs on 24 V DC channels. The circuit board which includes these is connected to the terminal unit:

* DSQC 101 (pre-autumn 1985)
* DSQC 124 (post-autumn 1985)

DSQC 101

The digital inputs/outputs are voltage supplied in accordance with the following:

The first standard board is supplied with internal 24 V voltage and is not galvanically isolated from the robot system.

DSQC 124

DSQC 124 is provided with two jumpers, W1 and W2, on delivery. The digital inputs/outputs are then voltage supplied with internal 24 V supply.

If the jumpers W1 and W2 are removed, the digital inputs/outputs will:

* Be galvanically isolated from the control cubicle.
* Require external 24 V supply.

The second standard board (arc welding and gluing systems) can be voltage supplied with 24 V internal or external voltage. When the board is supplied externally, the inputs/outputs are galvanically isolated from the robot system. The system can be provided with extra digital inputs/outputs of different types.

As the standard system, the arc welding system and the gluing system contain different sets of digital inputs/outputs, the standard system is described in sections 6.2.2 - 6.2.3 whereas the arc welding system is described in Chapter 14 and the gluing system in Chapter 15.

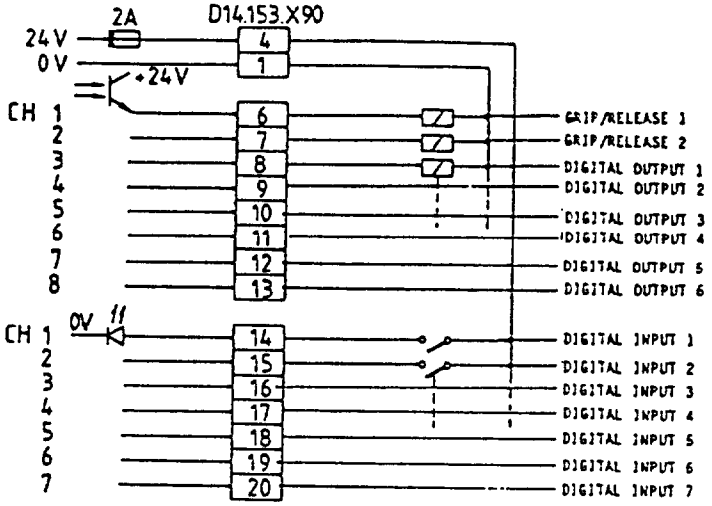
The system can be provided with extra digital inputs/outputs of different types.

These can be supplied externally and are then galvanically isolated from the robot system. Internal 24 V DC supply can also be used for extra inputs/outputs (see section 6.4.3) but galvanic isolation is then not obtained.

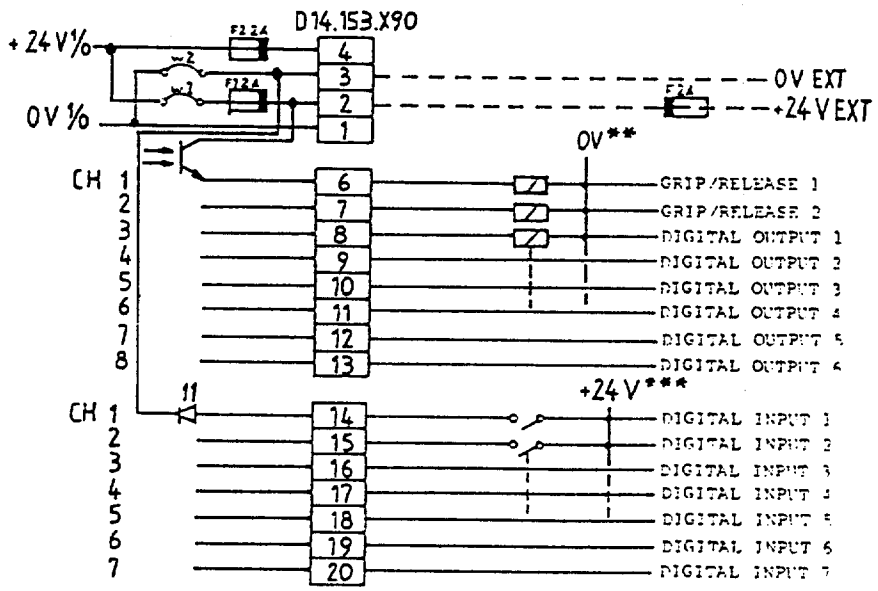
6.2.2 Basic set of digital inputs/outputs, standard system

Basic inputs/outputs (see Figure 6-5) are connected at the terminal unit D14.153 in the rear plane of the control cabinet H14. (Note the terminal unit has the same item designation as the associated digital board in the rack D14.) The outputs 5 - 6 and the inputs 5 - 7 are reserved for internal signal handling in the robot system.

DSQC 101



DSQC 124



** Is to be connected to:
- o Terminal 1, when +24 V I/O is supplying the outputs.
- o Terminal 4, when +24 V EXT is supplying the outputs.

*** Is to be connected to:
- o Terminal 4, when 0 V I/O is connected to the inputs.
- o Terminal 1, when 0 V EXT is connected to the inputs.

Figure 6-5

N.B. For arc welding connections see chapter 14.
For gluing connections see chapter 15.

GRIP/RELEASE 1 and 2 are outputs intended for two grippers and are controlled manually from the programming unit or automatically by the program. The outputs can be 1 or 0. For switching over to the mechanical robot, see section 6.5

DIGITAL OUTPUTS 1-4 are controlled from the program and can be set to 1 or 0, inverted or pulsed.

Option: Port 1, consisting of digital outputs 1 - 4, can assume any integer value ranging between 0 - 15. This value is written into a register, and then transferred to the port after binary coding of the value.

Digital Outputs

Port 1	1	First bit (LSB)	4 bits (value 0-15)
	2		
	3		
	4	Last bit (MSB)	

Figure 6-5A

DIGITAL INPUTS 1-4 are detected by the program and a test is performed to determine if the input is 0 or 1.

Option: The input 4-bit digital value at port 11, consisting of digital inputs 1 - 4, can be transferred to an internal register for further use internally.

Digital Inputs

Port 11	1	First bit (LSB)	4 bits (value 0-15)
	2		
	3		
	4	Last bit (MSB)	

Figure 6-5B

* (only for systems with absolute measurement)

For sequential transmission of numerical values

- from register to digital outputs, port 1 is used.
- from digital inputs to register, port 11 is used.

Together with the outputs 5 and 6 and input 5,

- port 1 receives port number 70 (port 1 can not be used then)
- port 11 receives port number 80 (the ports 1 and 11 can not then be used)

6.2.3
Extra digital inputs/outputs, standard system

Reference: System circuit diagram for:
1) Terminal numbers for terminal unit
2) Fusing on the terminal unit
3) Connection of supply on the terminal unit

The control system can be provided with up to four extra input/output units, each consisting of a connection unit located in the rear plane of the control cabinet, H14-H8, and an input/output board located in the rack D14. (Note that the terminal unit has the same item designation as the associated digital board.) The number of channels and technical data for the different board types are shown in Table 6-1.

The following equipment arrangement is used:

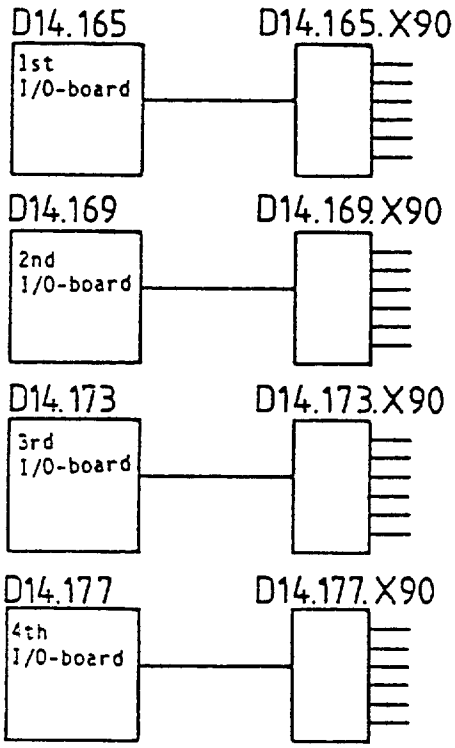


Figure 6-6

The type of input/output board according to table 6-1 at the different places in the figure 6-6 must be defined with function parameters according to chapter 10.

The extra inputs/outputs are normally supplied from an external voltage source. Internal 24 V DC-supply can also be used (see section 6.4.3).

For connection of power supply, see system circuit diagram and table 6.1.

Option: Values in the number register can in addition control the status of the following output groups after binary coding:

	12	First bit (LSB)	
	13		
Port 2	14		4 bits (value 0-15)
	15	Last bit (MSB)	
	16	First bit (LSB)	
	17		
	18		
	19		
Port 3	20		8 bits (value 0-255)
	21		
	22		
	23	Last bit (MSB)	
	24	First bit (LSB)	
	25		
	26		
Port 4	27		8 bits (value 0-255)
	28		
	29		
	30		
	31	Last bit (MSB)	

Figure 6-6A

Option: The status at the following input groups can in addition set values in the number register after binary decoding:

	11	First bit (LSB)	
	12		
	13		
Port 12	14	Last bit (MSB)	4 bits (value 0-15)
	15		
	16		
	17		
	18		
	19		
Port 13	20		8 bits (value 0-255)
	21		
	22	Last bit	
	23	First bit (LSB)	
	24		
	25		
	26		
Port 14	27		8 bits (value 0-255)
	28		
	29		
	30	Last bit (MSB)	

Figure 6-6B

Table 6-1

Data, digital input/output board

Board type	DSDX 110	DSDI 110	DSDI 130	DSDO 110	DSDO 131
Inputs:					
Number	16	32	16	-	-
Rated voltage	24 V DC	24 V DC	110 V DC/AC		
Input impedance	3.5 kohm	3.5 kohm	18 kohm		
1-level	+18 - +35 V	+18 - +35 V	± 90-140 V		
0-level	-21 - +2V	-21 - +2V	± 11 V		
Outputs:					
Number	16			32	16
Rated voltage	24 V DC			24-48 V DC	24-240 V DC/AC
Load capacity	max 150 mA*			max 150 mA*	max 3 A
Breaking power					max 44 W DC max 720 VA AC
Leakage current at 0-level	max 0.2mA			max 0.2mA	-
External supply Voltage, nom.	24 V DC			24-48 V DC	24 240 V DC/AC
Voltage, max	35 V DC			60 V DC	250 V DC/AC
Voltage, min	20 V DC			20 V DC	

* The outputs are not short-circuit protected.

Descriptions of signal functions at all input/output channels obtained at the extra input/output units follow. For terminal numbering, see the system circuit diagram.

First extra digital board with output channels

- CH 1 — RUN Active signal indicates that the system is in an operational status.
- CH 2 — CYCLE ON Active signal indicates that the program execution progresses. Follows the indication lamp in the button START on the programming unit.
- CH 3 — ERROR Active signal indicates that a program run error or servo error has developed in the system.
- CH 4 — PROGR. UNIT EXTRACTED Active signal when the programming unit is extracted from the programming unit compartment.
- CH 5 — GRIP/RELEASE 1 Duplicated function
- CH 6 — GRIP/RELEASE 2 according to basic I/O.
- CH 7 — SEARCH STOP The signal is active when search stop occurs with adaptive searching. It is de-activated when a new search instruction is programmed.
- CH 8 — DIGITAL OUTPUT 7
- CH 9 — DIGITAL OUTPUT 8

- CH 16/32 — DIGITAL OUTPUT 15/31

Second, Third ....extra digital board with output channels:

- CH 1 — DIGITAL OUTPUT 16/32
- CH 2 — DIGITAL OUTPUT 17/33

- CH 16/32

The number of robot outputs is increased with 16 or 32 channels in consecutive order for each further module.

First extra digital board with input channels

- CH 1 — INTERRUPT INSTR *) If the input is activated, the current instruction is interrupted. The subsequent program execution is in accordance with one of the following alternatives:
  1. If the input INTERRUPT PROGR is activated simultaneously, program execution is also interrupted.
  2. If the input JUMP PROG 1, 2 ... is activated simultaneously, a jump is made to the first instruction of the subprogram selected provided that JUMP PROG is activated at least 50 ms before INTERRUPT INSTR.
  3. If neither of the inputs INTERRUPT PROGR or JUMP PROGR 1, 2 ... is activated, program execution continues with the next instruction.

- CH 2 — INTERRUPT PROG *) If the input is activated, program execution is interrupted when execution of the current instruction is completed.

  If, in addition, the input INTERRUPT INSTR is activated simultaneously or during the time up to the end of the execution of the current instruction, the execution of the current instruction is interrupted.

- CH 3 — JUMP PROG 1 *) If the input is activated, a jump is made to the first instruction in subprogram 1 when execution of the current instruction is completed. When execution of the subprogram is completed, the execution of the next instruction in the program is begun.

  If the input INTERRUPT INSTR is activated simultaneously or during the remainder of the execution of the current instruction, this execution is interrupted and a jump is made directly to the subprogram. In this case, on return, the execution of the instruction interrupted is continued if this is a positioning instruction. In the case of a wait instruction, this is repeated.

- CH 4 — JUMP PROG 2 *) According to the above but subprogram 2

- CH 5 — JUMP PROG 3 *) According to the above but subprogram 3

- CH 6 — JUMP PROG 4 *) According to the above but subprogram 4

- CH 7 — JUMP PROG 5 *) According to the above but subprogram 5

- CH 8 — PROG START If the programming unit is in its compartment, the execution of the program begins when the input goes to an active status. A duplication of the program start of the control panel.

- CH 9 — PROG STOP The execution of the program is interrupted when the input goes to an active status. A duplication of the control panel program stop.

- CH 10 — DIGITAL INPUT 8

- CH 11 — DIGITAL INPUT 9

- CH 16/32 — DIGITAL INPUT 14/30

*) N.B. The system detects only transition to active status. This means that when an activated input has generated the associated function it must be reactivated to repeat the function.
The functions operate only when the program instruction ENABLE INTERRUPT has been executed.

Second, Third ...extra digital board with input channels

- CH 1 — DIGITAL INPUT 15/31

- CH 2 — DIGITAL INPUT 16/32

- CH 16/32

The number of robot inputs is increased with 16 or 32 channels in consecutive numerical sequence with each further module.

Example:

If the first input/output-unit is of the DSDX 110-type, the signal configuration and terminal connections to be in accordance with the figures below. (See also System Circuit Diagram.)

Terminal unit DSTD 160 (pre-autumn 1985)

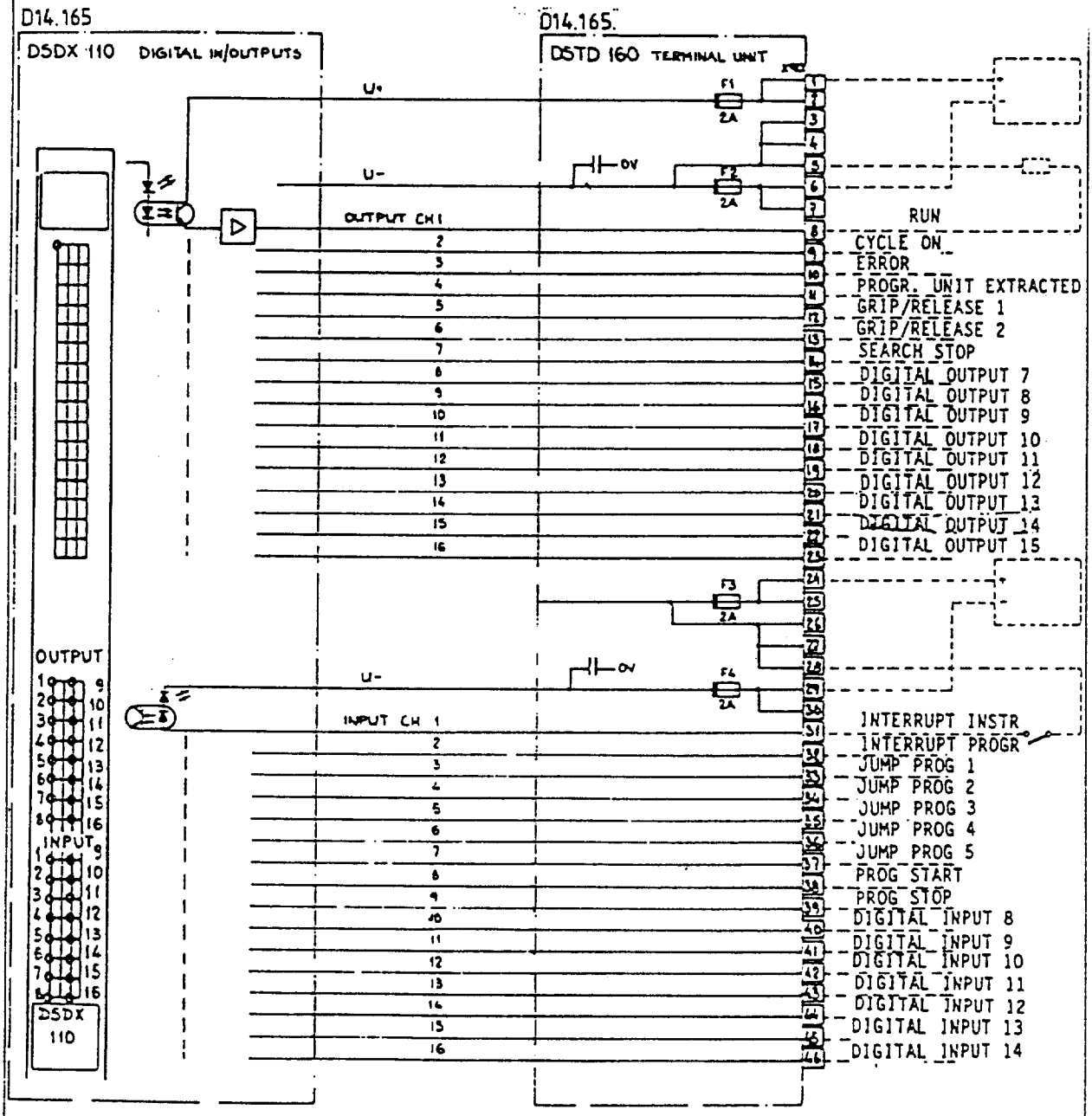


Figure 6-7a

Terminal unit DSQC 122 (post-autumn 1985)

Supply in groups of 2 x 16 inputs/outputs.

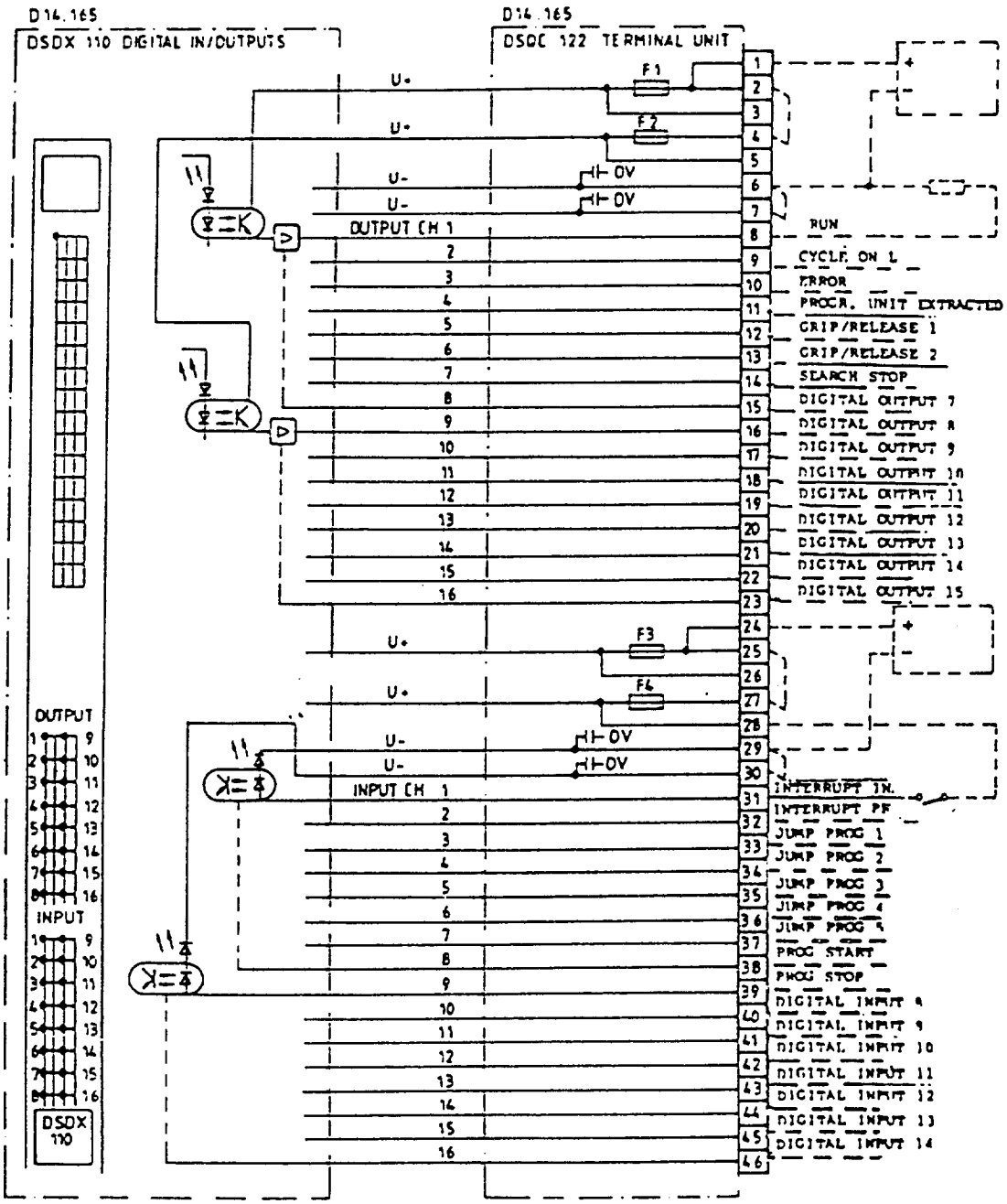


Figure 6-7b

Supply in groups of 4 x 8 inputs/outputs.

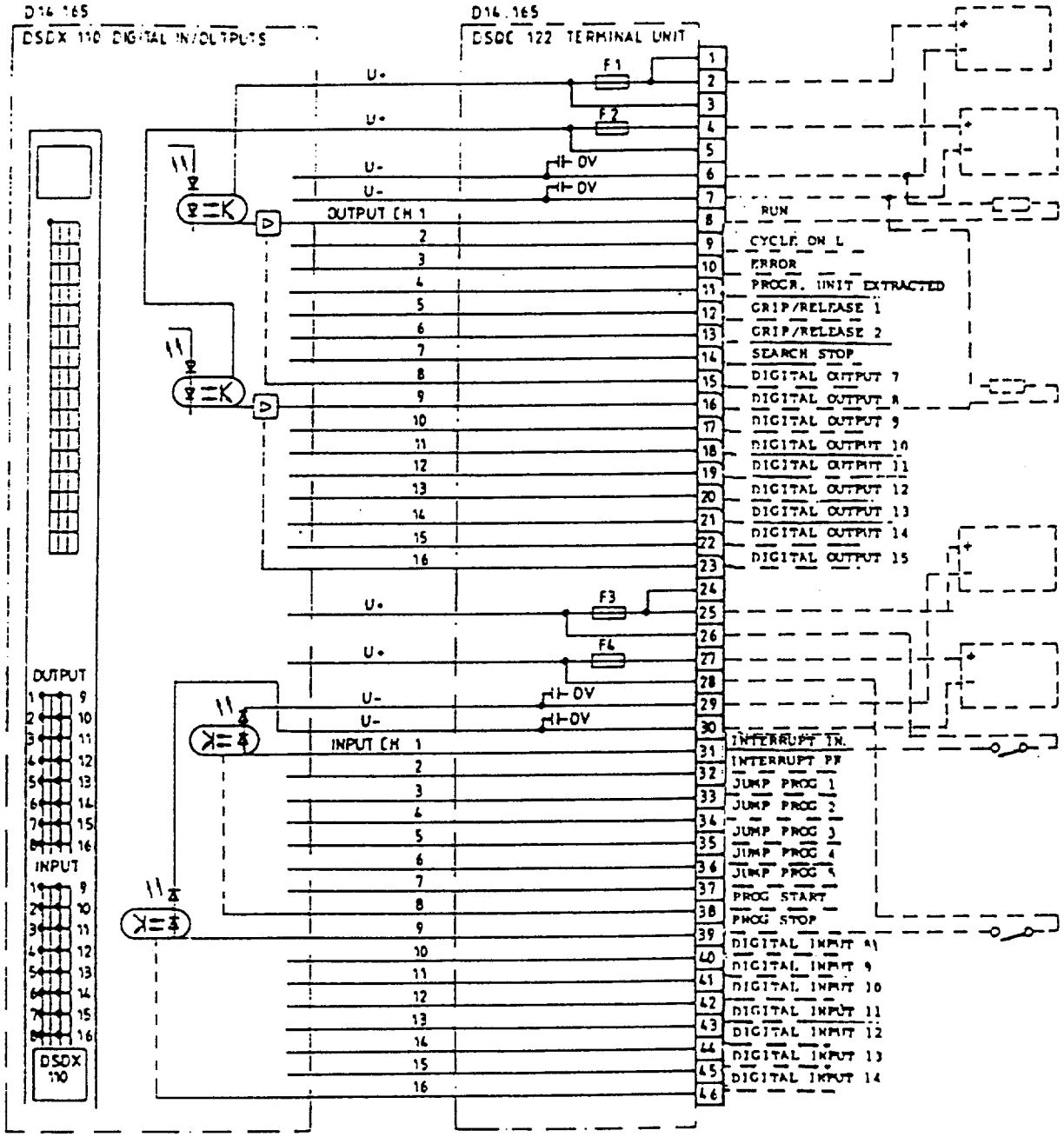
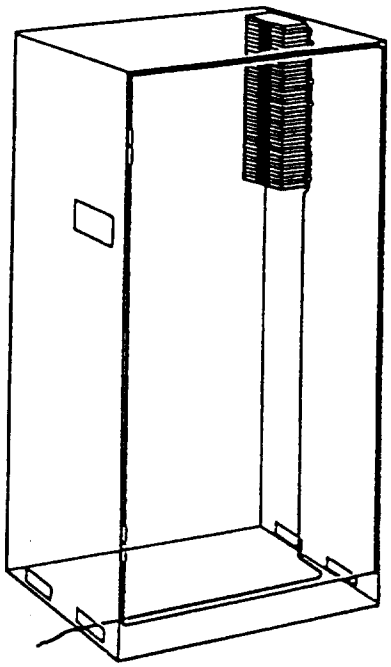


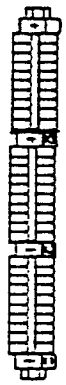
Figure 6-7c

If the control cabinet has been delivered with extra teminal units for 24 V supply, these are located in the top right hand corner of the cabinet, on the side wall as shown in the following figure:



The terminal unit is divided in groups of 10 terminals shown below:

Cabinet connections



External connections

No wires are connected to the terminals on delivery. Each terminal group can be supplied with either 24 V DC or 0 V, obtained from an internal or external voltage source.

N.B.
ASEA recommends that one side of the terminal block is to be used for cabinet connections and the other for connections to external equipment.

External components should never be supplied with 24 V from the internal cabinet supply to avoid the introduction of interference which might cause component malfunction.

6.3
Analog Inputs/Outputs

References: System Circuit Diagram for:
1. Terminal unit terminal numbering
2. Terminal unit fusing

The control system can optionally be provided with:

- 16 analog inputs for either adaptive control of the robot by means of analog sensors, see 7.2, or external control of the robot from internal number register. There are also 16 more inputs only for external robot control via registers.

- 4 analog outputs for control of external equipment from Internal number register.

The analog boards are located in the rack D14 and the associated terminal units are located in the rear plane H14 of the control cabinet. The following placing alternatives are possible, see figures 6-8 - 6-10.

1) Analog input board included in system.

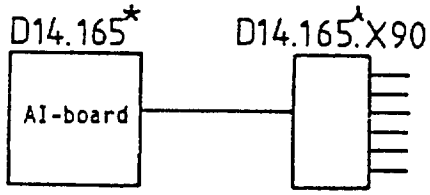


Figure 6-8

In addition, up to 3 digital input/output boards can be included on standard systems, but up to 2 digital boards on AW and GL robot systems.

2) Analog output board included in system.

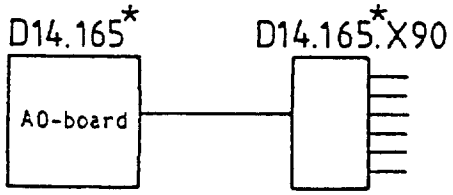


Figure 6-9

Up to 3 digital input/output boards can also be included on standard systems, but up to 2 digital boards on AW and GL robot systems.

3) Both analog boards are included

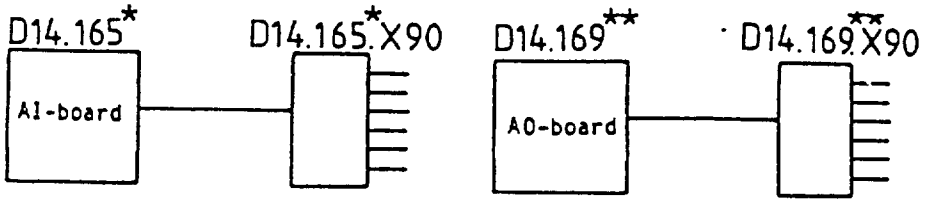


Figure 6-10

Up to 2 digital input/output boards can also be included.

* 169 for AW and GL robot systems
** 173 for AW and GL robot systems.

The type of analog board at the different places must be defined with function parameter in accordance with Chapter 10.

The numbering and channel numbers of the analog inputs are specified below:

CH 1	ANALOG INPUT (PORT 31)	Port value 0 - ± 1000
CH 2	ANALOG INPUT (PORT 32)	
CH 16	ANALOG INPUT (PORT 46)	
CH 32	ANALOG INPUT (PORT 62)	

Data:	Board type:	DSAI 120
	Inputs:	16, analog
	Input type:	Single
	Input voltage:	0 to ± 10.23 V
	Resolution:	10 mV
	Input resistance:	10^6 kohm voltage input

The numbers and channel numbers of the analog outputs are specified below

CH 1	PORT 21	Value 0 - ± 1000
CH 4	PORT 24	

Data:	Board type:	DSAO 110
	Outputs:	4 analog
	Output type:	Single

Alternative signal range:

Voltage signal 0 to ± 10.235 V Range 0-100 % Resolution 5 mV (R > 500 Ohm)

Current signal 0 to ± 20.47 mA Range 0-100 % Resolution 10 µA (R < 450 ohm)

The board is delivered strapped for voltage signals on all channels. The change to current signal is performed by changing the straps for the channel concerned. See System circuit diagram.

A third signal range can be used for a particular channel, current signal 0 to ± 10.23 mA, Range 0-100 %, resolution 5 µA. (R < 900 ohm).

1. Change the channel concerned to a current signal (see System Circuit Diagram)
2. Remove (with a soldering iron) straps in accordance with the figure below

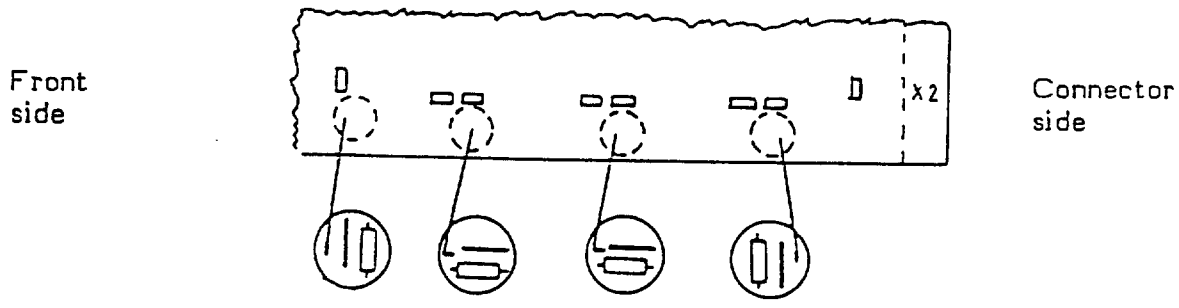
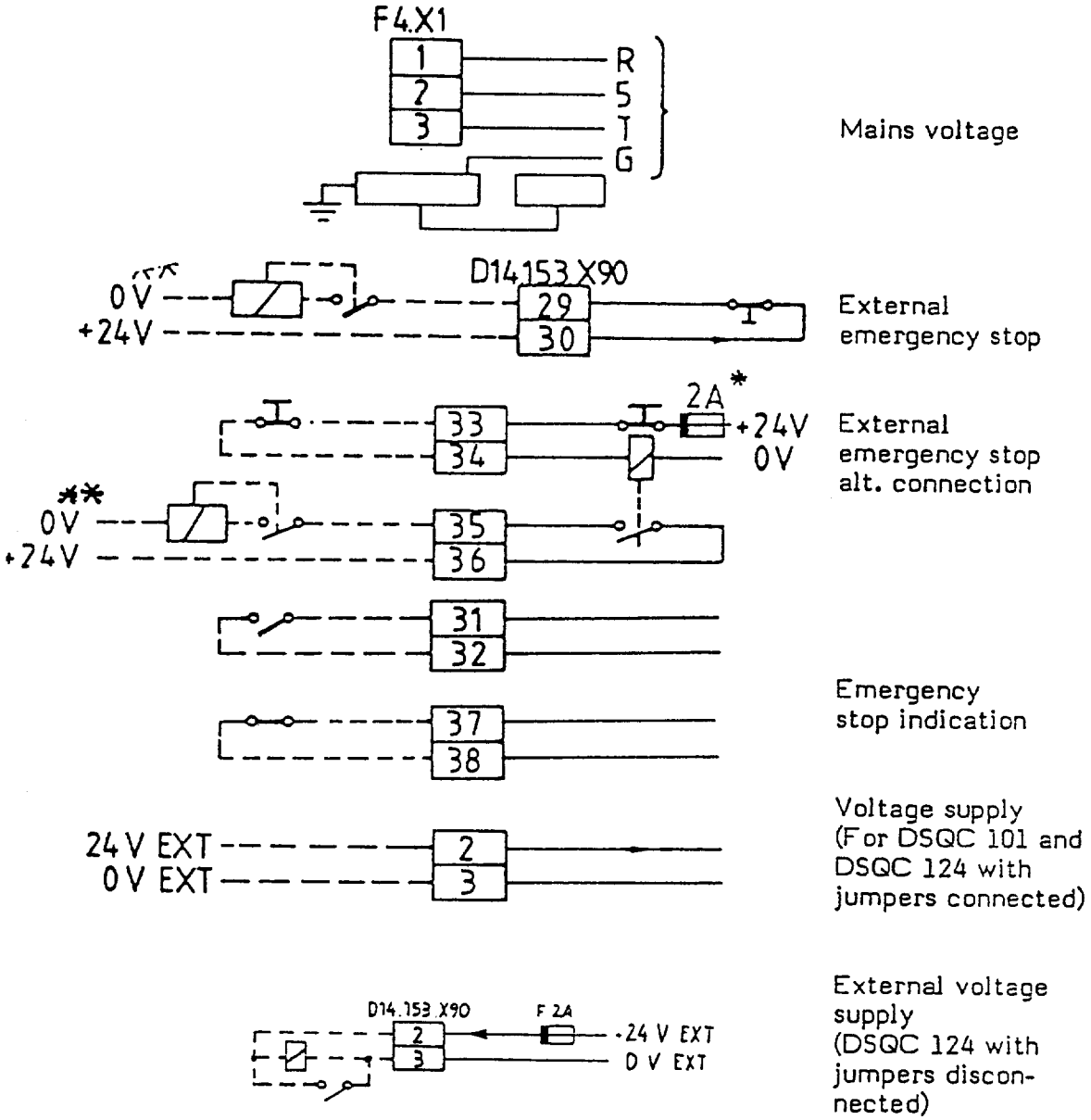


Figure 6-11

6.4
Various signal connections in the control cabinet

6.4.1
Basic connections

The terminals available to the user in the control cabinet, in addition to digital and analog signal connections are shown in Figure 6-12



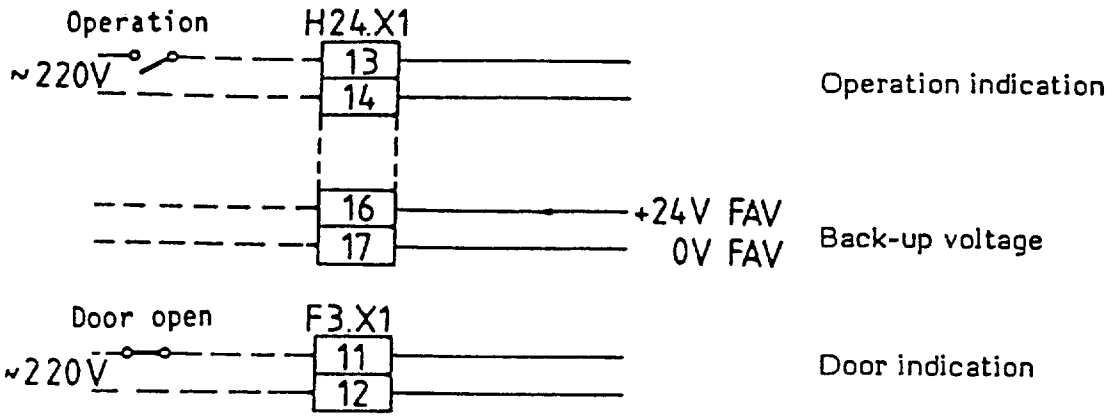


Figure 6-12

* If the relay coil is short-circuited, damage may occur in the control cabinet.

** For DSQC 124: External or internal supply, see 6.4.3.

6.4.2
Dead man's handle

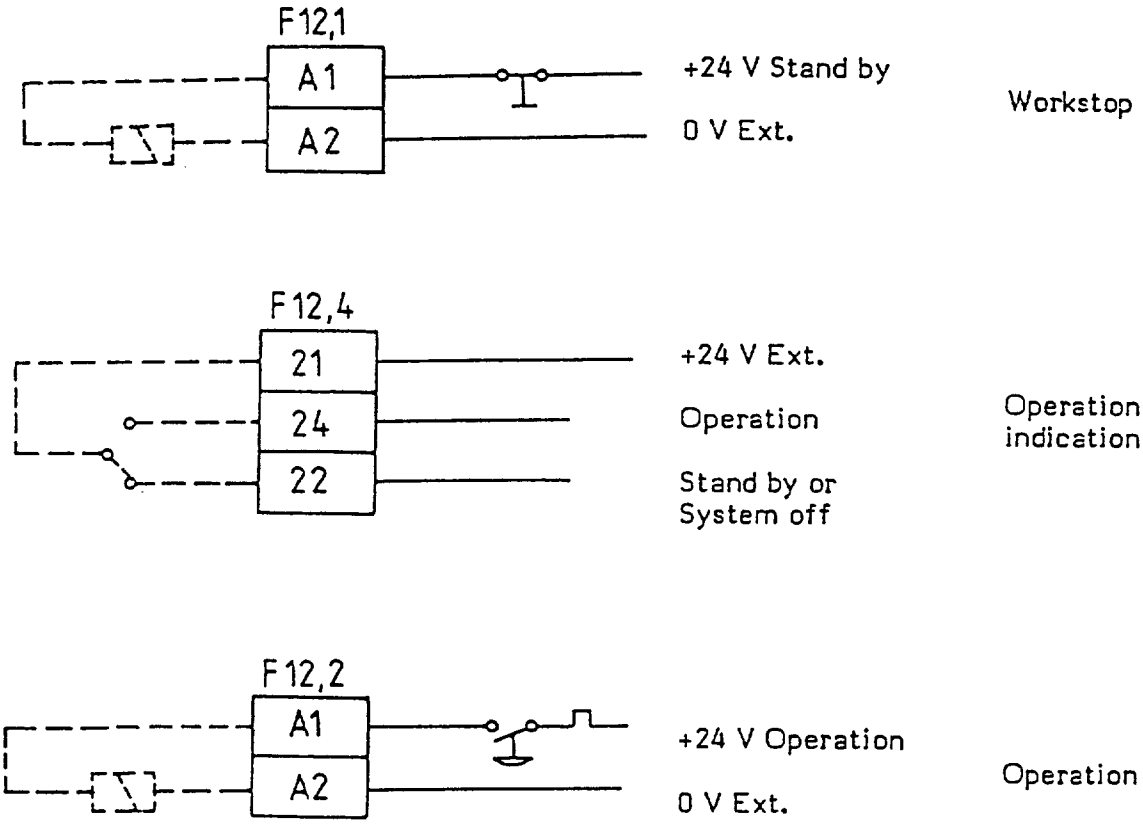


Figure 6-13

6.4.3
Emergency stop connections

For external emergency stop connections, there are two contact inputs to trip the emergency stop and two contact outputs to indicate that the system is in an emergency stop status. These are located on the unit D14.153. The emergency stop can be tripped directly via a contact or indirectly via an externally supplied relay coil (available on robot systems with manufacturing numbers as from 7330 238).

Contact input:

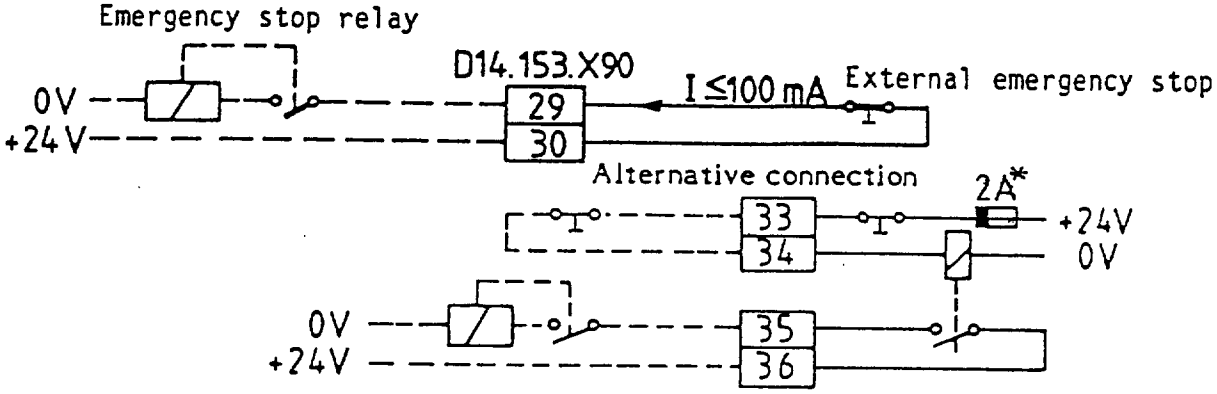


Figure 6-14

N.B! If any of the terminal pairs 29-30, 33-35 or 34-36 are not used for external emergency stop, corresponding strappings must be inserted.

For DSQC 124 it is possible to supply the emergency stop chain according to the following alternatives:

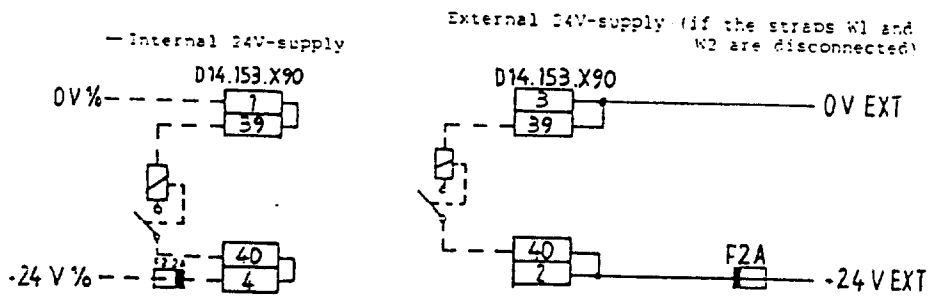


Figure 6-15

Data:

Voltage (external)	Max 30 V DC
Rated voltage	24 V DC
Current	max 100 mA
Internal resistance:	Normally 3 ohms. "Worst case" 8 ohms (both external control panel and external programming unit compartment connected).

In both cases, the input is normally closed. If the input is opened, an emergency stop is triggered in the control cabinet. To reset the emergency stop, it is necessary that the input be closed and that the resetting be performed with the OPERATION or STANDBY buttons.

Contact output:

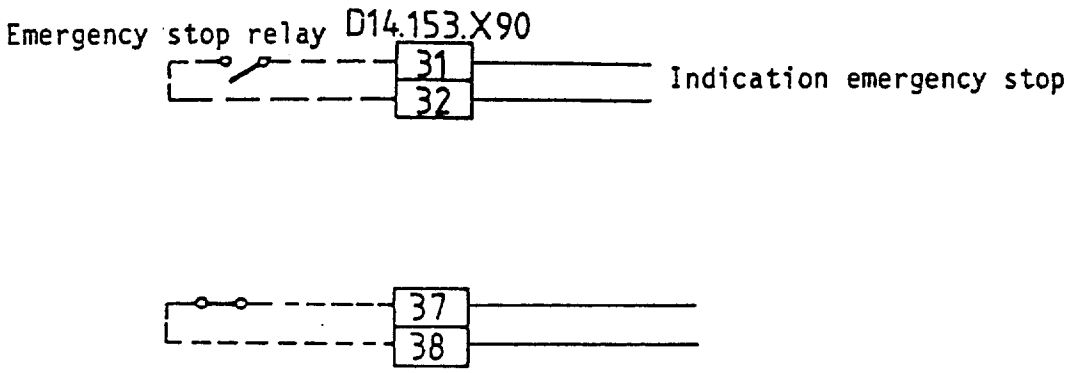


Figure 6-16

The figure 6-16 shows the contact positions when an emergency stop is triggered.

Data:

Voltage (external)	Max 60 V
Load capacity	Continuously, max 1 A At switch on/off, max. 5 A

6.4.4
Voltage

For DSQC 101 and DSQC 124 with connected jumpers (on delivery), the following apply:

+24 V DC unregulated voltage is available in the control cabinet at the terminal unit D14.153. The connection can be used either for external use or to supply extra digital inputs/outputs. (see section 6.2.3).

Figure 6-17

Output data:

Voltage	21-32 V DC, not galvanically isolated
Rated voltage	24 V DC
Current	max 2 A
Ripple	2 V p-p

When jumpers W1 and W2 have been disconnected, the terminals are used for external 24 V-supply of the basic set of inputs/-outputs. The emergency stop chain or extra digital inputs/outputs can also be supplied from here (see 6.2.3 and 6.4.3 respectively) in this case.

6.4.5
Emergency voltage for memory back-up

When the main or safety switch of the control system is switched off, separate voltage is required for the read/write memory. The system contains battery back-up of the read/write memory for at least 1500 hours after a power failure.

A reserve voltage supply is to be connected for memory back-up during longer power interruptions. This voltage is used to maintain the charge of the system batteries.

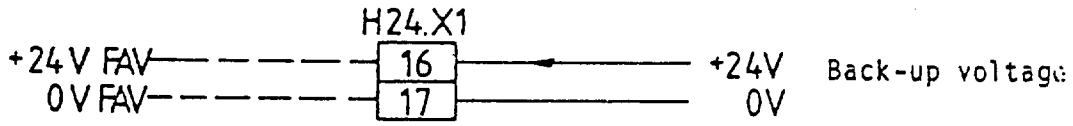


Figure 6-18

Data:

Voltage	18-32 V DC
Rated voltage	24 V DC
Rated current	10 mA

6.4.6
Contact output, operational status

A 220 V AC contact output is provided which is active when the system is in RUN status. The output is normally used for connection of an operational timer but can also be used for other purposes.

The RUN signal is also available at the digital status output, see action 6.2.3.

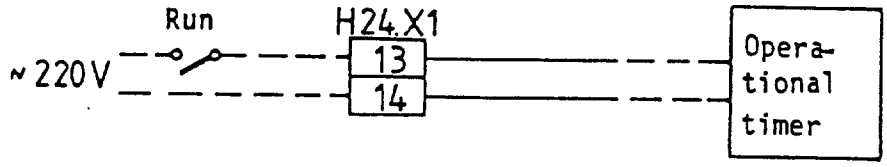


Figure 6-19

Data:

Voltage	220 V AC
Loading	max 30 VA

6.4.7
Contact output, open cabinet door

A 220 V AC contact output which is activated when the control cabinet door is open is located on the fan unit F3. The output is primarily used for connection to a lamp and/or flashing alarm in the control cabinet.

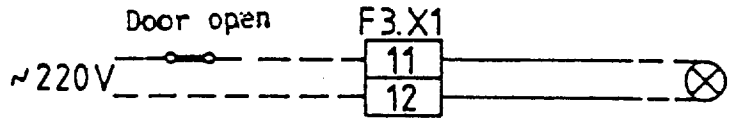


Figure 6-20

Data:

Voltage	220 V AC
Loading	max 60 VA

6.4.8
Mains output for service

A double 220 V mains voltage output with a separate switch is located inside the control cabinet for supply to test and service aids.

The maximum power output is 600 VA and the output is fused with a 6 A fuse.

N.B. This output is not intended for electrical drills and such, since this would introduce interference to the system!

This voltage is normally available at the output when the main switch and safety switch are "On".

If this mains output is to be connected directly so that voltage is available independently of the main switch, the existing cables to the fuse/main switch and the earth are to be disconnected and 220 V is to be connected from an external supply. Alternative connections are possible, see Figure 6-21.

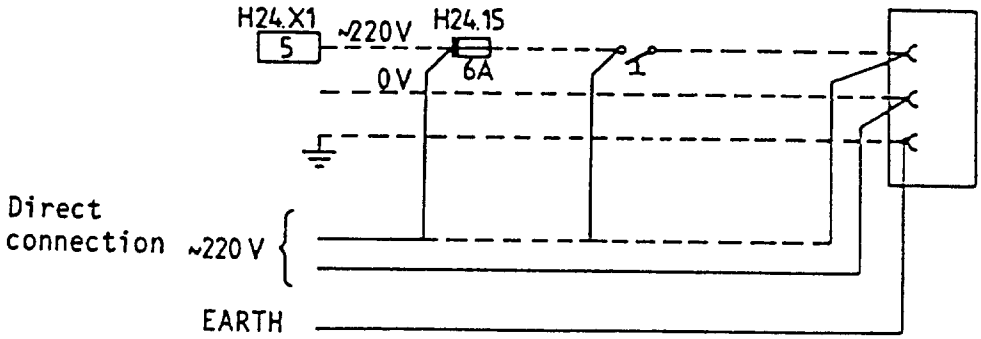


Figure 6-21

The control system can, as an alternative, be provided with Red Spot-fuses. The fuses as well as a transformer 220/110 V and an English standard wall outlet are included. The connection is shown in Figure 6-22.

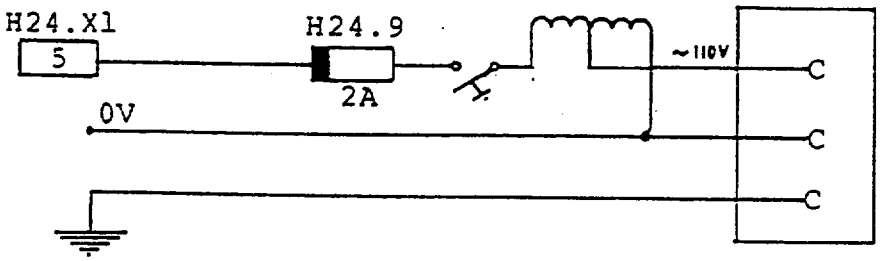


Figure 6-22

Note, if the output is to be used for connection of earth connected measurement instruments and terminals, the zero conductor in the external supply must have the same potential as the control cabinet earth, as component failure in the control electronics may otherwise result.

6.4.9
Dead man's handle and workstop (option)

See also section 12.2, Personnel safety.
6.4.2, Connections

Dead man's handle

The safety plate on the programming unit acts as a dead man's handle when the programming unit is lifted out of its compartment. This happens whether the workstop is activated or not.

The action of the dead man's handle is as follows: The robot is in the operating stage when the safety plate is pressed down and in stand-by when the plate is not activated. Note that the safety plate also works when the workstop is activated and has priority over the workstop to facilitate programming on entering the robot risk zone.

Consequently the safety plate also works when the programming unit is in its compartment, provided that the workstop is activated (under these conditions the workstop could be said to simulate the lifted out programming unit).

Workstop

The workstop can be used, for example, when it is necessary to enter the risk zone for servicing or some other action. From the personnel safety angle the workstop operates in the same way as the emergency stop function but it is not connected with the emergency stop loop.

When the workstop is activated the robot goes to stand-by mode if the safety plate of the programming unit is not pressed. The workstop is activated when the 24 V supply is cut off and is made inactive when the 24 V supply is connected again.

The workstop signal is connected via F12.1.A1 +24 V, F12.1.A2 0 V.

Stand-by mode is indicated at F12.4.21 - 22 N
F12.4.21 - 24 NO (F12.4.11-12-14 is reserved for internal use)

Start after workstop is only possible after workstop has been reset. Resetting itself does not give operating mode; this is obtained in the usual way from the control panel or externally by a signal at F12.2.A1 +24 V, F12.2.A2 0 V. This 24 V signal pulse must be more than 100 ms long.

When the robot system is delivered the workstop is disconnected by means of strappings at F12.0.1 and F12.0.2. THESE STRAPPING MUST BE REMOVED WHEN WORKSTOP SIGNALS ARE CONNECTED. The operation of the Dead man's handle is not affected by this.

Data

Relay function:	Double switching contacts
Coil:	
Voltage	20-29 V DC
Rated voltage:	24 V DC
Contacts:	
Voltage max.	220 V AC, 220 V DC
Current max.	2 A at voltage max.

N.B: Robots fitted with Dead man's handle and workstop are normally delivered with the maximum number of brakes on the robot axes.

6.5
Signal connections to robot (option)

Signal cables which can be utilized by the user for transmission of various control signals are provided between the control cabinet and the robot, see Figure 6-19. Such signals can be, for example, signals to and from grippers or from sensors on the robot.

Seven of these signal cables are accessible in the control cabinet at the terminal unit (D14.153) terminal blocks and they are connected to the control equipment with leads to the I/O terminal block required, see Figure 6-23. The location of contacts on the robot is shown in Figure 6-24.

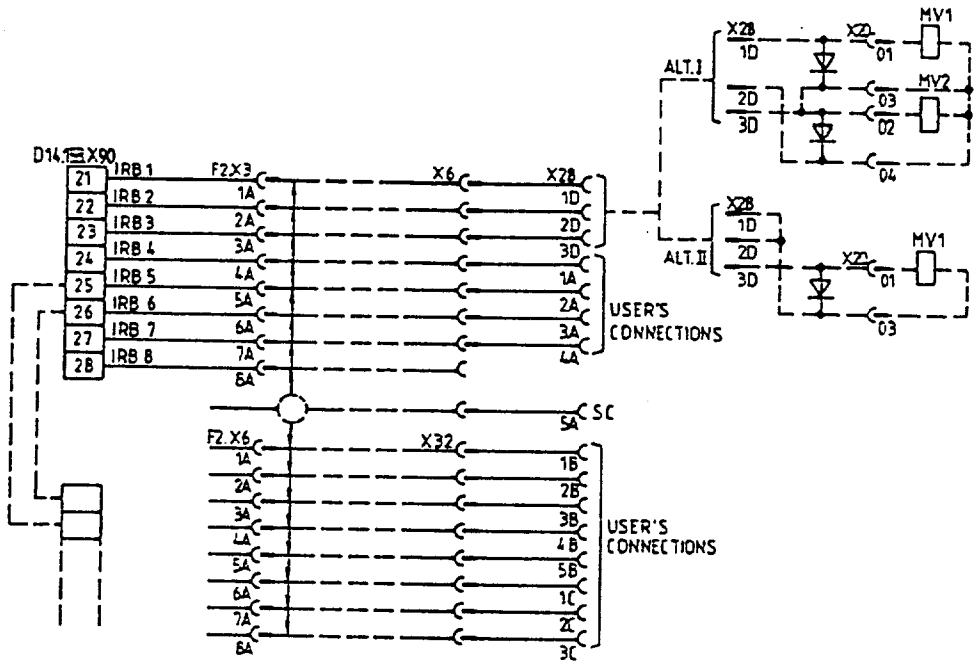


Figure 6-23

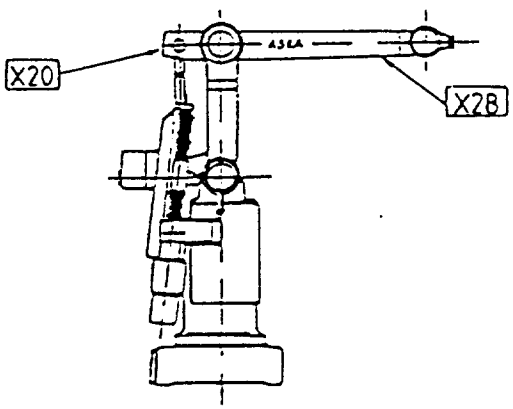


Figure 6-24

If the leads are used to connect relays, coils or other components generating interference, these must be suppressed in accordance with the instructions in Chapter 5.

6.6 Connection of external controls

When the control panel or programming unit is delivered for external installation, the control cabinet is provided with a cover plate where these are normally located.

It is important that the enclosures for panel and compartment are sealed and that they are provided with a protective earth to the central earth.

6.6.1 External Control Panel

The dimensions of the control panel and the space required are shown in Figure 6-25.

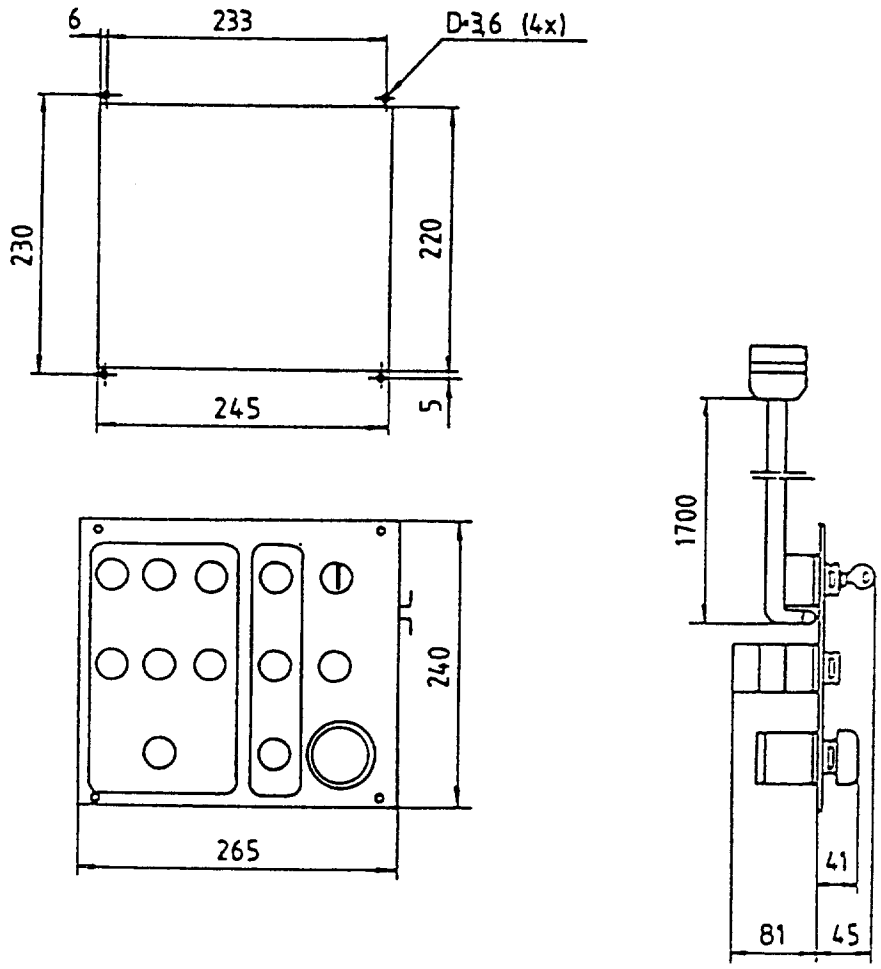


Figure 6-25

The control panel is installed and connected as shown in Figure 6-26. The length of the cable connecting the control panel to the cabinet may not exceed 30 m. The panel is normally delivered with a cable 6, 10 or 15 meters long. An RTXG connector is installed at each end. See Chapter 13 for the connection/disconnection of RTXG connectors. The cable is connected as shown in Table 6-2.

The wiring from the control panel is introduced to the control cabinet through the cover plate at F2 via the cable gland Ø 16 mm, up to the contact F6.X1 and F6.X2 as shown in Figure 6-26.

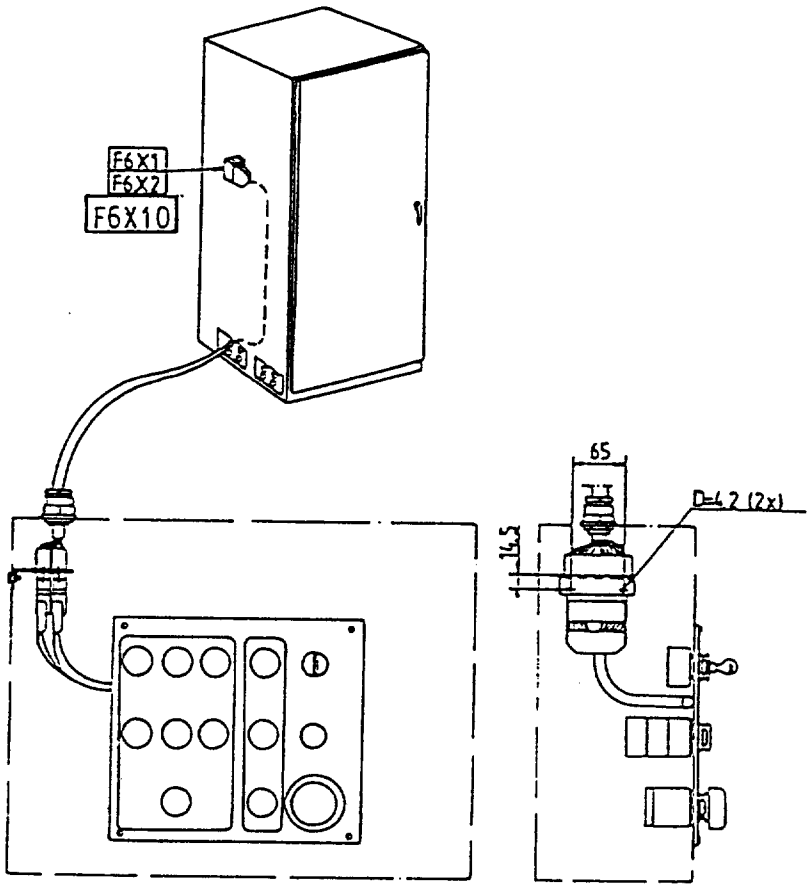


Figure 6-26

Table 6-2 Connections

Connector	Output	Cable No.	Connector	Output	Cable No.
F6.X1	A1	1	F6.X2	A1	17
	B1	2		B1	18
	A2	3		A2	19
	B2	4		B2	20
	A3	5		A3	21
	B3	6		B3	22
	A4	7		A4	23
	B4	8		B4	24
	A5	9		A5	25
	B5	10		B5	26
	A6	11		A6	27
	B6	12		B6	28
	A7	13		A7	29
	B7	14		B7	30
	A8	15		A8	Screen
	B8	16		B8	31

6.6.2 External programming unit compartment

The dimensions and space requirement for the programming unit compartment are shown in Figure 6-27.

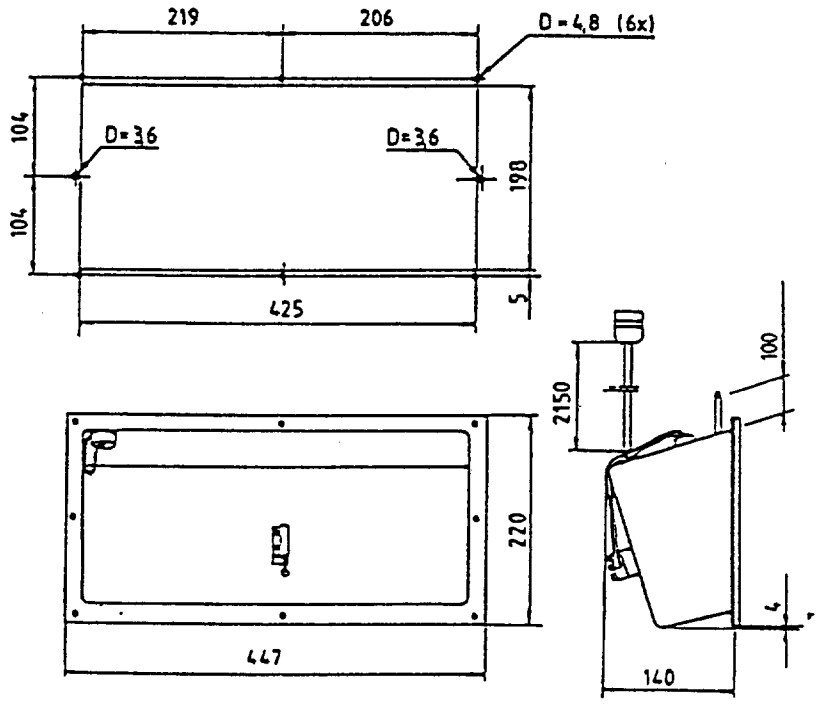


Figure 6-27

The programming unit compartment is installed and connected as shown in Figure 6-28.

The length of the connection cable between the programming unit compartment and the cabinet may not exceed 15 m. The cable normally provided is 6, 10 or 15 meters long.

The lead for the programming unit screen is screwed directly to the enclosure.

The wiring from the programming unit compartment enters the control cabinet through the cover plate F2 via a Ø 16 mm cable gland and is drawn to contact F6.X3 as shown in Figure 6-28.

An RTXG connector is installed on each end of the cable delivered with the compartment. See Chapter 13 for the connection/disconnection of RTXG connectors.

The cable is connected in accordance with Table 6-3.

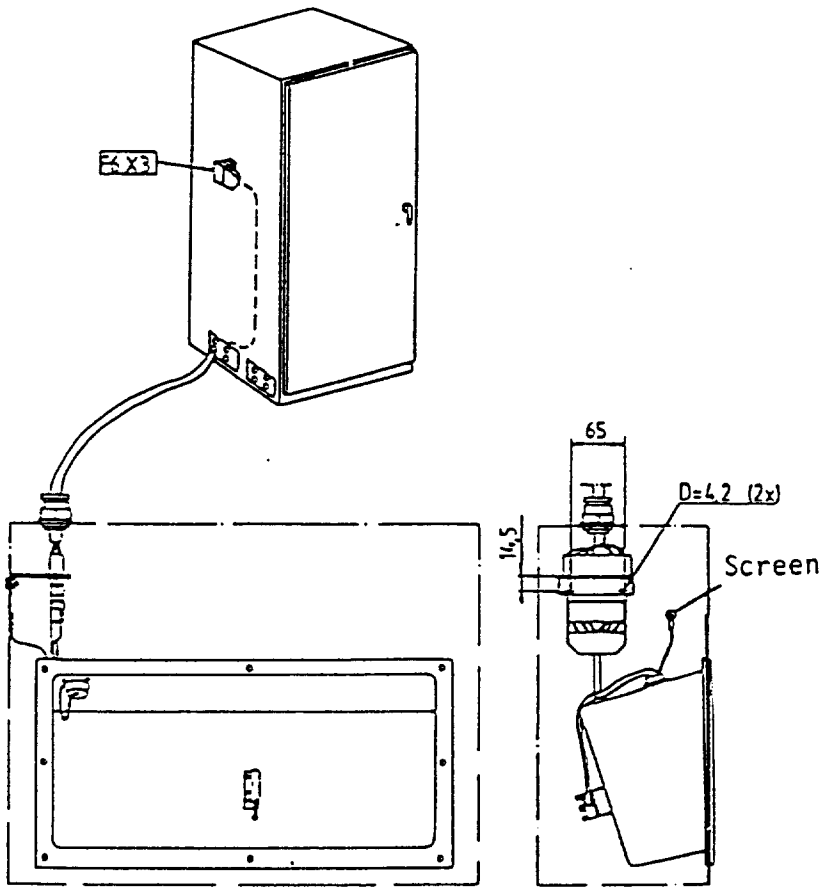


Figure 6-28

Table 6-3

Connector	Output	Cable No.
X3	A1	1
	A5	2
	B1	3
	A2	4
	A3	5
	B3	6
	A4	7
	B4	8
	B2	9
	B5	10
	A8	Screen

6.6.3
Remote control (option)

References: System Circuit Diagram

The function remote control consists of a relay interface unit containing 14 relays of plug-in type, mounted on a terminal bar at position F13.

Remote control is meant for multiplying the functions of the control panel and enables free-of-choice external connection of the signal concerned.

The relays 1-6 have their coils connected in parallel with the corresponding lamps on the control panel and potential free contact outputs for external indication.

The relays 7-14 have their contacts connected in parallel with the corresponding control panel pushbuttons. Their coils are not connected and meant for external control.

Connection

Principle relays 1-6

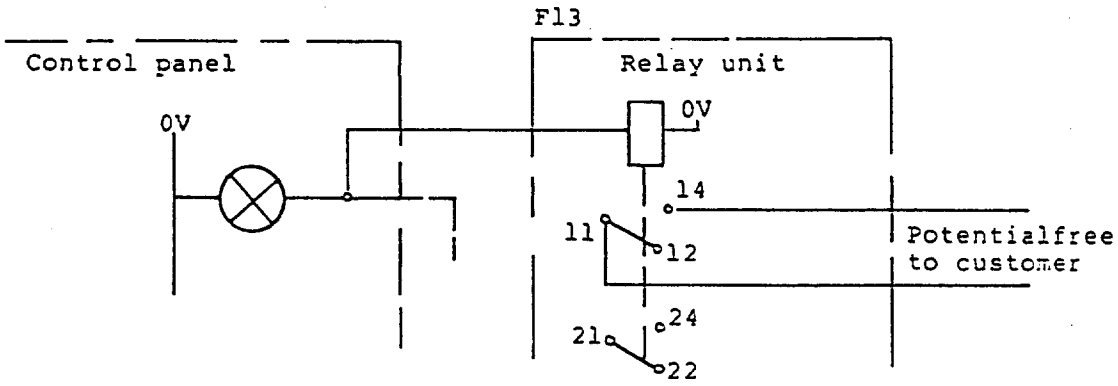


Figure 6-29

Principle relays 7-14

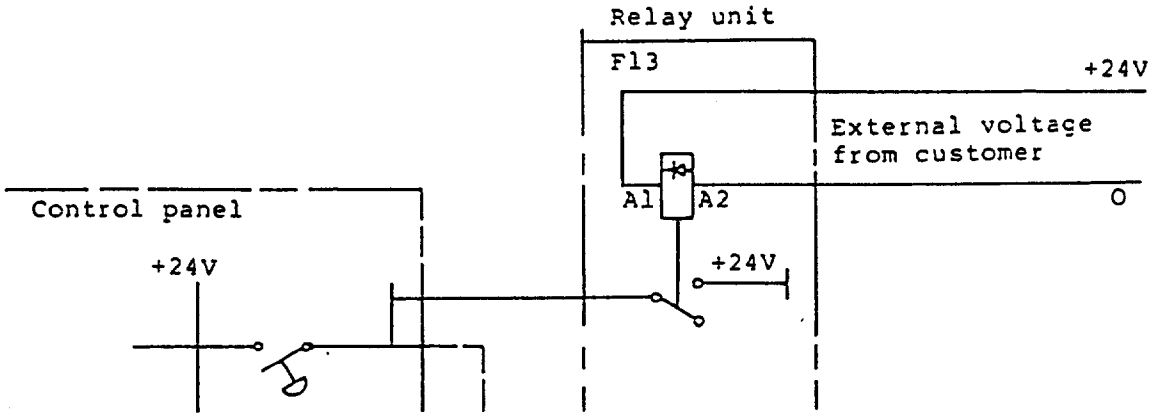


Figure 6-30

The external control of OPERATION and STANDBY, relays 11-13, have a different internal contact connection. This is because they are also meant to reset EMERGENCY STOP. The connections are shown in the System Circuit Diagram. The relays contain two diodes, one LED which indicates activated relay and one diode connected in series with the coil which in turn means that +24 V always must be connected to the terminal A1.

N.B.
The LAMP TEST function is disconnected from the control panel and thus prevents relays 1-6 to become activated when the test is performed.

When synchronizing an already synchronized robot system, the SYNC button must be pressed twice (two signals required). In that case a reset to program 0 is also performed.

Data

Relay function:	Double switching contacts
Coil:	
Voltage	20-29 V DC
Rated voltage	24 V DC
Contacts:	
Voltage max.	220 V AC, 220 V DC
Current max.	2 A at maximum voltage

6.7
Serial communication unit

References: System circuit diagram for
1) Terminal numbering on connection unit
2) Fusing on connection unit
3) Connection of supply on the connection unit

The control system can be provided with a serial communication unit for program printout and for a computer link. The unit consists of a connection unit located in the rear plane, H14 of the control cabinet, and a serial communication board located in the rack, D14. Note that the connection unit has the same item designation as the board.

The serial communication board is always placed to the left of any extra input/output board, see fig 6-31.

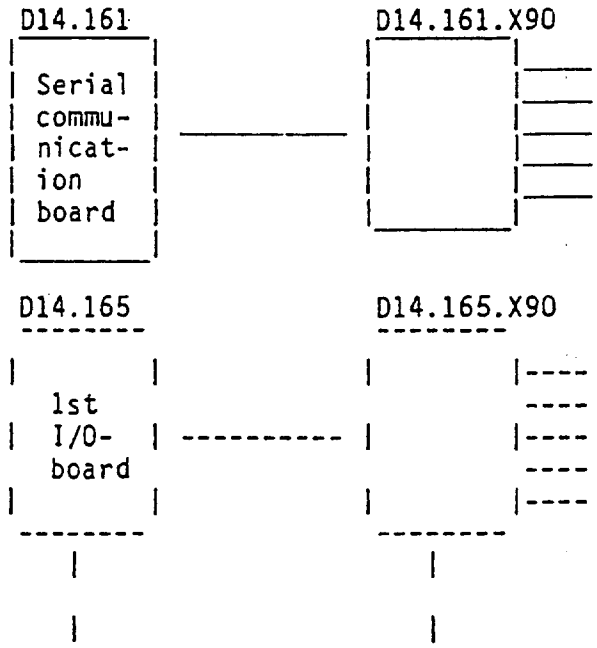


Figure 6-31

The serial communication board must be defined with function parameters as described in chapter 10.

The board contains four channels. The connection to each channel can be either

- V24/RS232 interface up to 15 m from the control cubicle
- Short range modem to units at distances 15 up to 300 m from the control cubicle.

Equipment for program printout is always connected to channel 0 and the computer link to channel 1 as shown in figure 6-32.

-	CH 0	V24/RS232 Short range modem	Program printout
-	CH 1	V24/RS232 Short range modem	Computer link

Figure 6-32

Data:

Number of channels:	4, only CH 0 and CH 1 are used.
Signal interface:	V24 and short range modem
Transmission speed:	Up to 38 400 bits/s total for channels.
Word length:	5, 6, 7 or 8 bits
Parity:	Odd, even or none
Stop bits:	1, 1 1/2 or 2
Block buffer:	128 + 96 byte/channel
Supply requirement, typical:	5 V, 1.8 A
Supply requirement, max:	5 V, 2.4 A
Insulation test voltage:	50 Hz/1 min. 2 x 5 kV

If the robot system is prepared for program printout, a 220 V output and a 25-pole socket connector, F11.X.1 are located on the right hand side at F11. An adapter cable with a corresponding pin connection, F11.X2 and a "D" connector F11.X3 (socket) are also supplied (see fig. 6-32).

The wiring for the computer link is connected directly to the connection unit D14.161.X90 on the rear plane in the control cabinet.

7
CONNECTION OF SPECIAL EXTERNAL EQUIPMENT

7.1
Grippers

A gripper can be connected to the turning disk on the wrist. The fixing dimensions are shown in Figure 7-1. To permit easy change of gripper, they are located with the outer circumference of the turn disk and a guide hole Ø 6 H8.

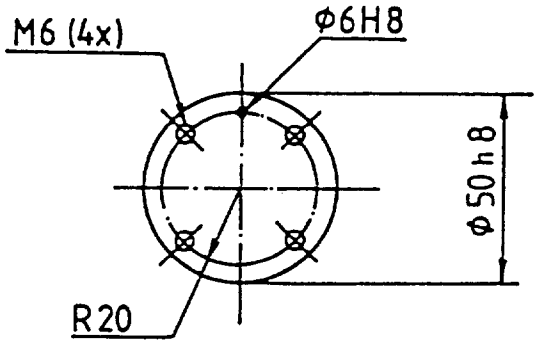


Figure 7-1

Pneumatic gripper

The robot is to be provided with a solenoid valve unit to permit control of the air supply. This is installed in the upper arm and is provided with a 5/2-way solenoid. Figure 7-2 shows how the compressed air supply is connected.

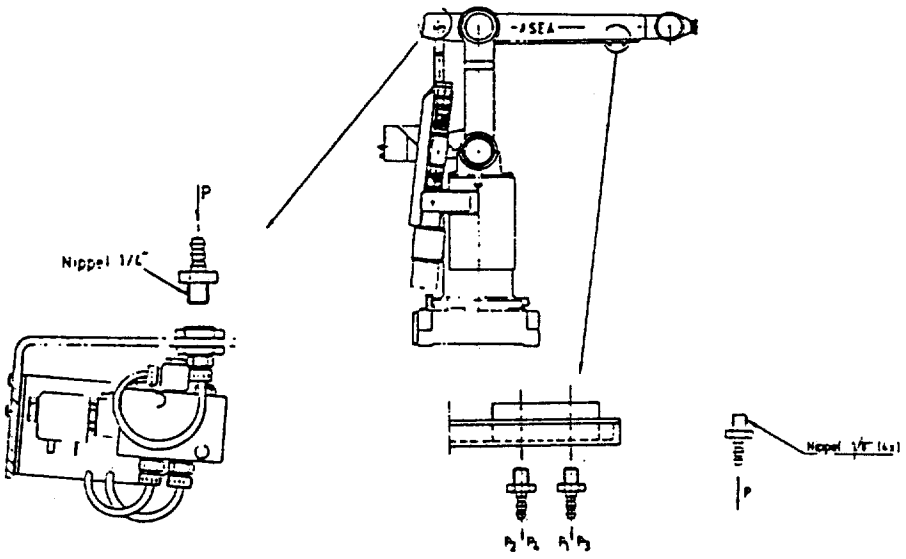


Figure 7-2

The solenoid valve is controlled by digital outputs specially intended for control of grippers, see section 6.2.

Electrically controlled gripper, or similar

In this case, solenoids are not used. For the electrical connections, the customer connections routed to the upper arm of the robot as shown in Figure 6-20, section 6.5, are used. The grippers are otherwise controlled in the same way as a pneumatic gripper.

N.B! Any coils in the gripper are to be suppressed as described in Chapter 5.

7.2 Sensors

Up to 16 sensors can be connected to the control equipment for adaptive control of the robot (see Programming Manual).

The control system must also be provided with an adaptive control program to permit use of sensors. The sensors are to be defined with sensor data as described in Chapter 10.

Connections are provided on the mechanical robot, prepared for any sensors to be installed, as described in section 6.5.

The sensors can be of the analog or digital type;

a) Analog sensors

The control system must be provided with analog inputs as described in section 6.3 for the connection of analog sensors. The analog signals can be sensitive to interference and are to be protected as described in Chapter 5.

An analog sensor is connected to the analog input with the same number as the sensor. The number of the sensor is defined with sensor data, see section 10.3.

b) Digital sensors

Existing digital inputs are used for connection of digital sensors, see section 6.3.

Digital sensors can be of three different types:

1) On/Off-type
2) Three level type
3) Multi-level type

Sensors of on/off-type are connected to a digital input, three level sensors are connected to two digital inputs and multi-level sensors can be connected to a maximum of eight digital inputs corresponding to multi-level sensors with eight bits, one bit being a sign bit. Each digital input thus represents one bit.