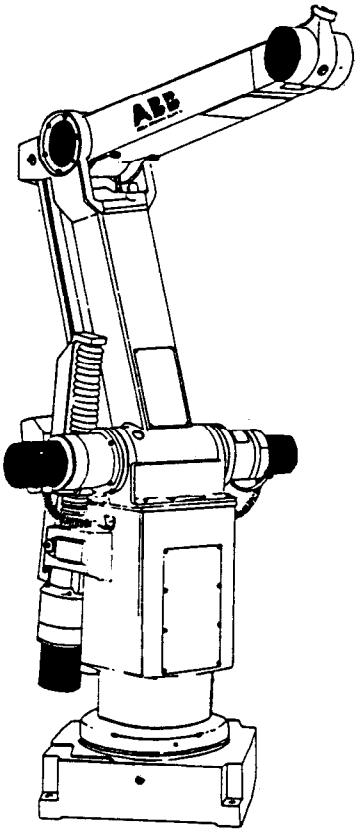
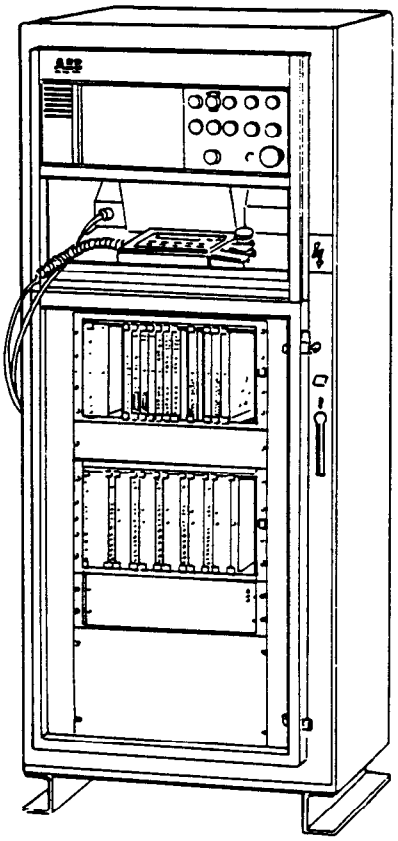
Description
IRB L6E





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ASEA BROWN BOVERI

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Contents: Page

1 INTRODUCTION

The ABB 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.

IRB L6E is a further development of the IRB 6, which was first delivered in 1973 and is mainly used for arc welding and material handling. It is also suitable for grinding, deburring, polishing and tending machine groups.

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.

Separate electrical and mechanical sections

The ABB 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 L6E is intended to be mounted standing up, but it can without modifications be mounted in an inverted position.

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 coordinates, 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 with 3 ½ " floppy disks. 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.

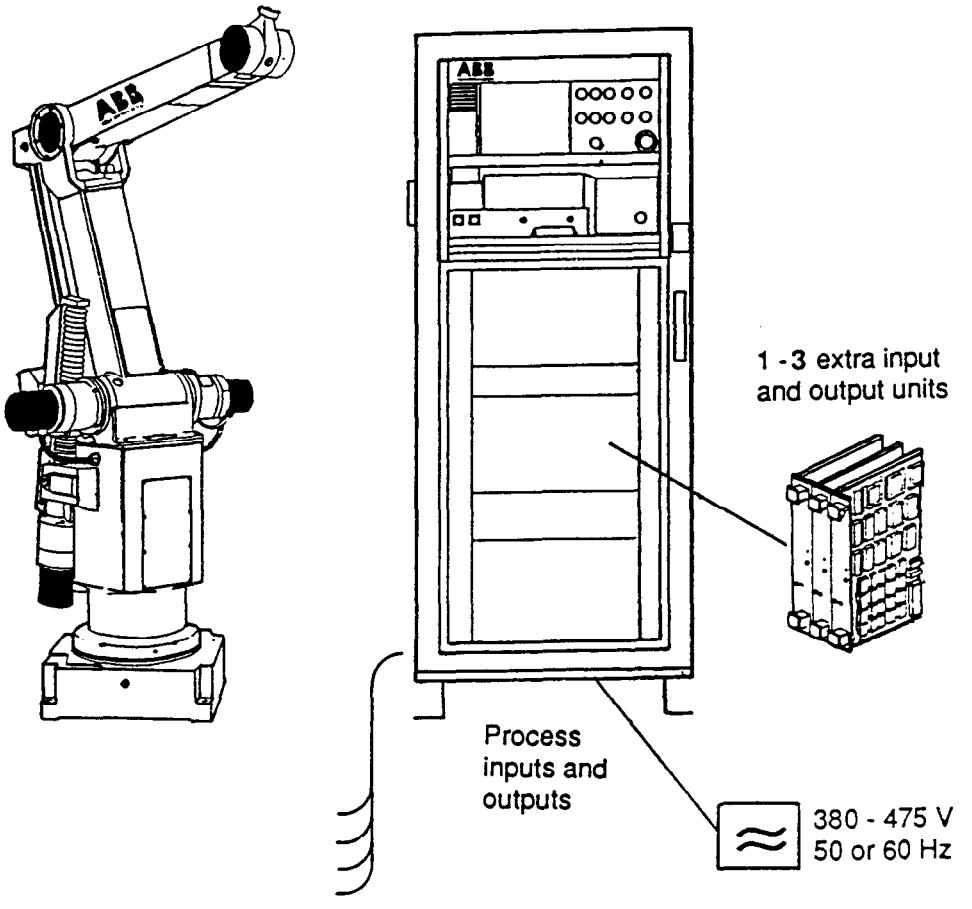
Emergency stop with self-supervision

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.

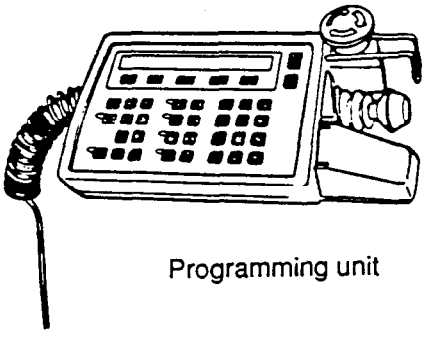
Safety functions

The safety circuits in the robot system are designed with self-supervising components or with a two-channel principle with self-supervision. Self-supervision means that a fault causes the robot system to enter the STANDBY mode. All types of system stops (emergency stop, work hold and safety hold) result in the system going to the STANDBY mode.

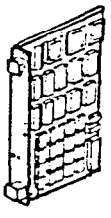
The Industrial Robot System consits of a basic version and a variety of optional accessories, see below. The basic version, the mechanical robot together with a control cabinet, can be supplied in a number of variants.



Accessories to control equipment

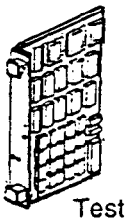


Programming unit

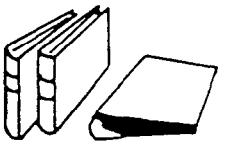


Extended
read / write
memory

Field servicing



Test adapter



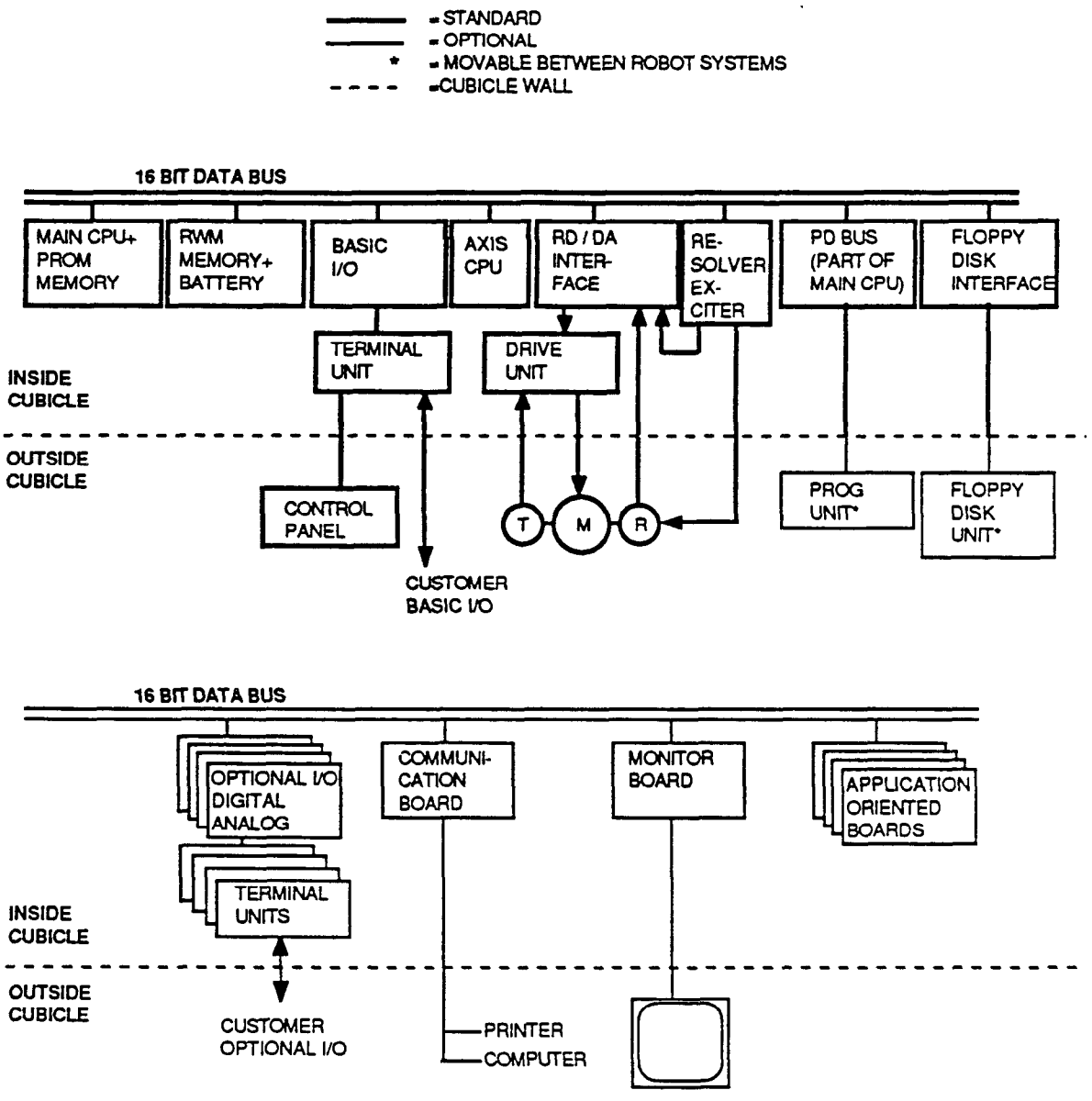
Documentation

3.1
Control cabinet

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 10 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.

The arm movements are made by means of ball screws which actuate the arms through levers. 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.

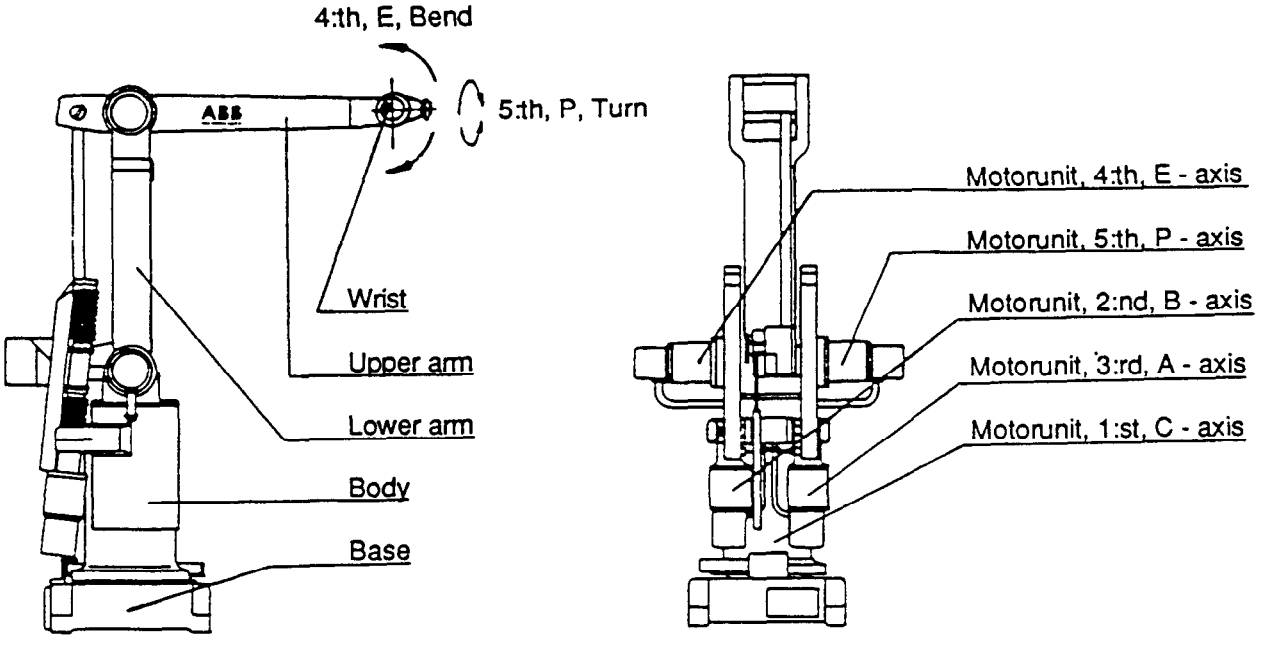
The motor units and mechanical transmissions for all robot axes, except for the 1:st (C) axis which is mounted inside the body, are located on the outside of the rotating body of the robot.

The motor units consist of a DC motor, a tachometer for speed control and a resolver for indication of position. Brakes on all axes are standard. As an option, the remaining axes can be fitted with brakes.

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.



4
OPERATION AND PROGRAMMING

4.1
Controls

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 **programming unit** is connected to the control system by a 10 m cable. When not in use, it is placed in a compartment on the door of the control cabinet or removed from the robot system. The compartment also contains the connection for the cable. For safety reasons a contact must be present at all times in the connection (either the programming unit contact or the supplied dummy contact).

The programming unit is provided with membrane buttons, which give tactile feedback, and LED displays. The emergency stop button and the safety pad for the function of the joystick are placed on each side of the horizontal joystick and protects it. The programming unit withstands a hostile industrial environment.

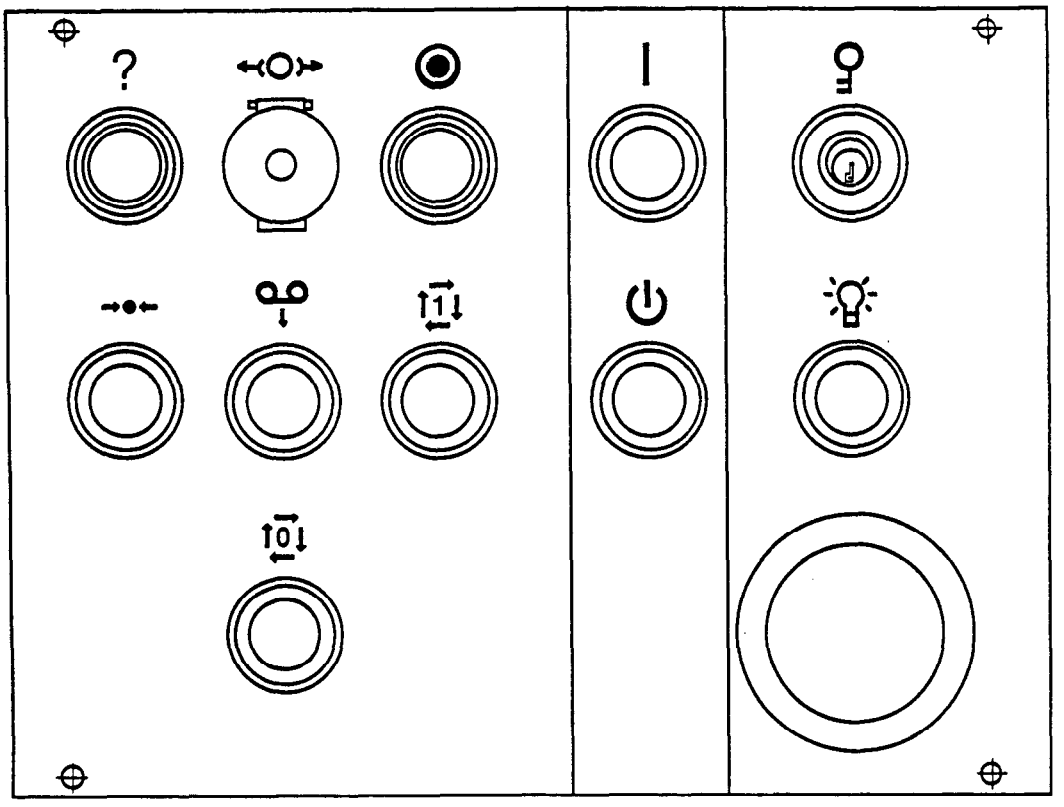


Figure 4-1 Control panel

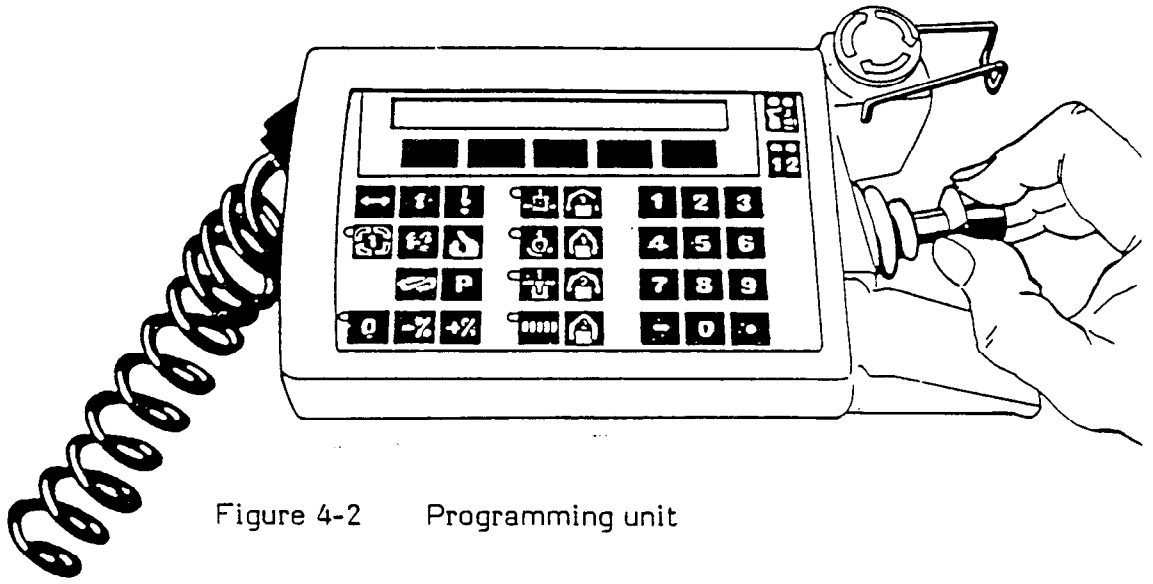


Figure 4-2 Programming unit

All operator communications, with the exception of selection of the operational mode for the robot system, are available on the portable programming unit. The programming unit is provided with the following facilities for this purpose:

- o **A two-row alphanumeric display for messages in plain language.**
  The system can display:
  - texts in any of four languages; English + three other languages,
  - numerical values in international (metric) or inches.

- o **Five multi-function buttons below the panel.**
  The text on the lower row of the display defines the use of the multi-function buttons.

- o **Six to eight menus for most of the system functions.**
  Each menu contains a particular type of function, for instance for program editing.

- o **Joystick.**
  The robot, or external axes, are positioned by using the joystick, together with the safety pad and the switches on the upper right-hand corner.

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 emergency stop circuits are self-supervisory. This means that an emergency stop is caused by the occurrence of any malfunction in the circuits concerned.

- The maximum speed of the robot is limited to 250 mm/s speed when the programming unit is connected and has been extracted from its compartment.

- The dead man's handle (option) relay unit including self-supervisory circuits for work hold and safety hold.

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

  The safety pad at the joystick works as a dead man's handle for the robot movements when work in the hazardous area is carried out.

  Safety stop prevents obtaining of RUN status before stop circuits were reinstated.

- Input from key switch (only with dead man's handle) allowing 100 % speed with the programming unit extracted from its compartment.

- A program can only be started from the programming unit when it is connected and has been extracted from its compartment.

- Immediate program stop controlled by a direct input signal.

- Resolver monitoring, which initiates an immediate emergency stop if a resolver signal is not received, or represents an anomalous value.

- 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 caused.

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

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.

Programs can contain instructions for robot movements in either straight-line or robot coordinates.

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 S	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 ABB 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. The door of the control cabinet is provided with a vision panel 1086 x 660 mm.

The programming unit (standard) is used for manual operation and programming of the system. The programming unit is fitted with a 10 m cable.

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.

Brake on robot axis. The robot system is provided with holding brakes on all robot axes. 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.

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. The program is stored in the memory of the control system, or on floppy disks by means of a floppy disk unit.

The following principal functions are provided in the basic version:

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

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

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

- **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.
  - 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.
  - Activation of "HOLD-TO-RUN" control.

- **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.

- Circular interpolation defined as three points on a circular arc in space. For circular arcs 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.

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.
- Copying of instructions.
- 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.

o **Adaptive control**

The following functions are provided:

- 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).

5.2.3
Technical data

	Number of servo-driven degrees of freedom			5
Performance	Type of movement	Axis	Working range	Max. speed
	Rotational movement	1:st (C)	360^{o}	$114^{o}/s$
	Radial arm movement	2:nd (B)		1.3 m/s
	Vertical arm movement	3:rd (A)		1.3 m/s
	Tilting wrist movement	4:th (E)	$\pm 90^{o}$	$138^{o}/s$
	Turning wrist movement	5:th (P)	$\pm 180^{o}$	$234^{o}/s$

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	$< \pm$ 0.2 mm
Maximum moment of inertia	0.24 kgm^2
Maximum static load	12 Nm
Power consumption	
Operation	0.6 - 2.0 kW
Stand-by	Approx. 0.5 kW

Environmental factors

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

Physical data

Weight	
Mechanical robot	145 kg
Control cabinet	350 kg
Dimensions	
Mechanical robot H x B x D (transport position)	1325 x 728 x 965 mm
Control cabinet	1900 x 800 x 600 mm

Electrical connections

Mains connection

Main voltage (Other voltages are available as options, see specific. form.)	3 phase, 380 V +12 %, -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)	$\leq$ 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	**120 (0-119)**
Permissible values	**0 $\pm$ 32767**

Sensors, connection possibilities

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.)	

5.3
Variants of the basic version

(Numbers in brackets refer to the specification form.)

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.

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.

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

Digital input/output capacity (10)

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

- 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 **three**(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

Dead man's handle **(14)**

The option contains:

- Safety pad on programming unit as dead man's handle.
- Work hold.
- Safety hold and a key switch program test run at 100 % of programmed speed.

The option "Dead man's handle" requires brakes on all axes (standard on IRB L6E).

Hardware for this function includes a relay unit and a "100 %"-key switch. To obtain high safety, the relay unit has double circuits for detection if the programming unit is in its compartment and if the safety pad is depressed. Relay logic is used to compare the input signals.

A work hold can be tripped in three different ways:

- A programming unit connected to the robot system is extracted from its compartment.
- The key switch for running at 100 % speed is set in the "on" position.
- Work stop circuit connected by the user is opened.

The RUN status can be obtained temporarily during a work stop by pressing the safety pad on the programming unit. The system returns to STANDBY when the pad is released.

The safety pad works as a dead man's handle using the relay unit hardware to switch between RUN and STANDBY status.

The following functions are blocked during a work hold:

- Program loading from floppy disk
- Synchronization.

During work hold, program start is possible only from the programming unit. The safety pad must be pressed.

Safety hold can only be caused by opening of external safety circuits connected to run chain inputs of the relay unit. The opened safety circuit must be closed before it is possible to run the robot again.

The relay unit has an input for the "100 %"-key switch in the programming unit compartment. When this switch is "on", the robot will run with the programmed speed, otherwise work hold will cause speed limitation to 250 mm/s.

Documentation (17)

Documentation supplied with the robot includes:

- Programming manual

- Product manual

  The Product manual contains:
  - o Descriptions
  - o Installation manuals
  - o Maintenance manuals
  - o Circuit diagrams
  - 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 (22.2)
the control cabinet can be provided with:

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

NA version (22.3)

- US-approved main switch according to local requirements.
- The option "program print" lacks mains connection.

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.

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.
- One or two solenoid valves are to be installed on the robot.

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

Computer link (24.4)

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.

5.4 Accessories

Separate descriptions of some of the accessories are available.

5.4.1 Control Equipment

Extended program memory (115)

The capacity of the user memory can be extended with an extra memory board in the electronics rack. The total capacity will then become 32 kword. This corresponds to 3 120 instructions - whereof 50 % are positioning instructions and 50 % are logical instructions.

5.4.2 Mechanical robot

Work range limitation (250)

The add-on kit gives a possibility to reduce the working range of the main robot axes. Mounting of the kit is done by the customer in conjunction with robot installation. Mounting instructions are included.

For axis 1, the kit includes mechanical stops and an electrical switch. The switch is to be mounted on the robot base exterior.

For axes 2 and 3, the programmed limitations of the working range are moved to the required positions, and the mechanical stops are fitted just beyond these.

Test adapter for fault tracing in system (500)

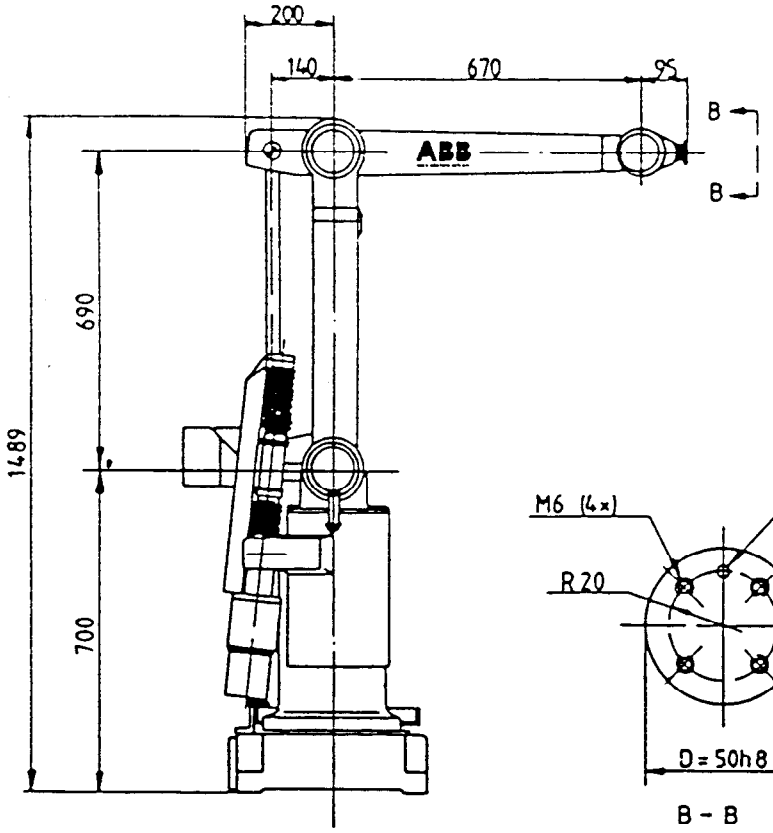
The test adapter can be of assistance when a fault in the system has been confirmed, but has not been localized with the help of the error messages displayed, the test points or the LEDs. The test adapter is inserted in the electronics rack and contains a number of test programs which the operator, in 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.

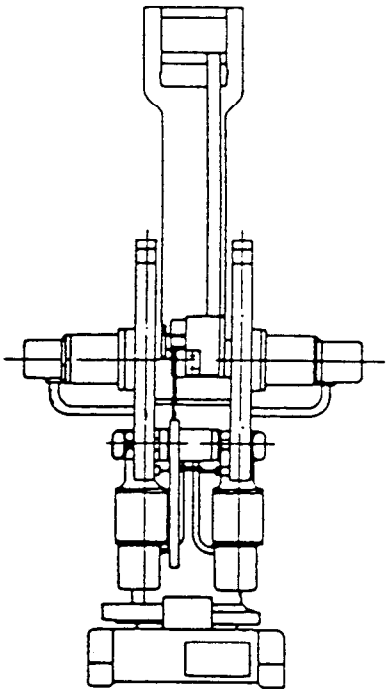
Extension board (530, 531)

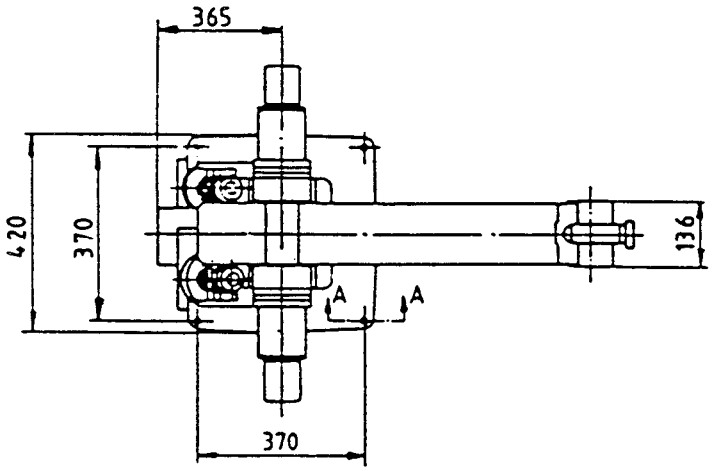
Measurements can be carried out on boards, even when they are mounted in the electronics rack, by means of an extension board outside the rack. This board is available in two forms; with a 64-pole process signal connector, and with a 28-pole connector.

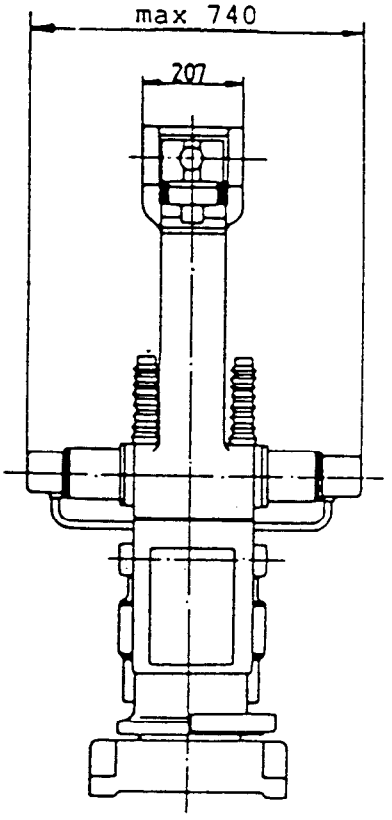
5.5
Dimensioned drawings

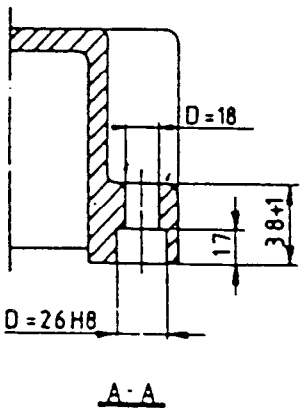
Dimensions in millimetres.



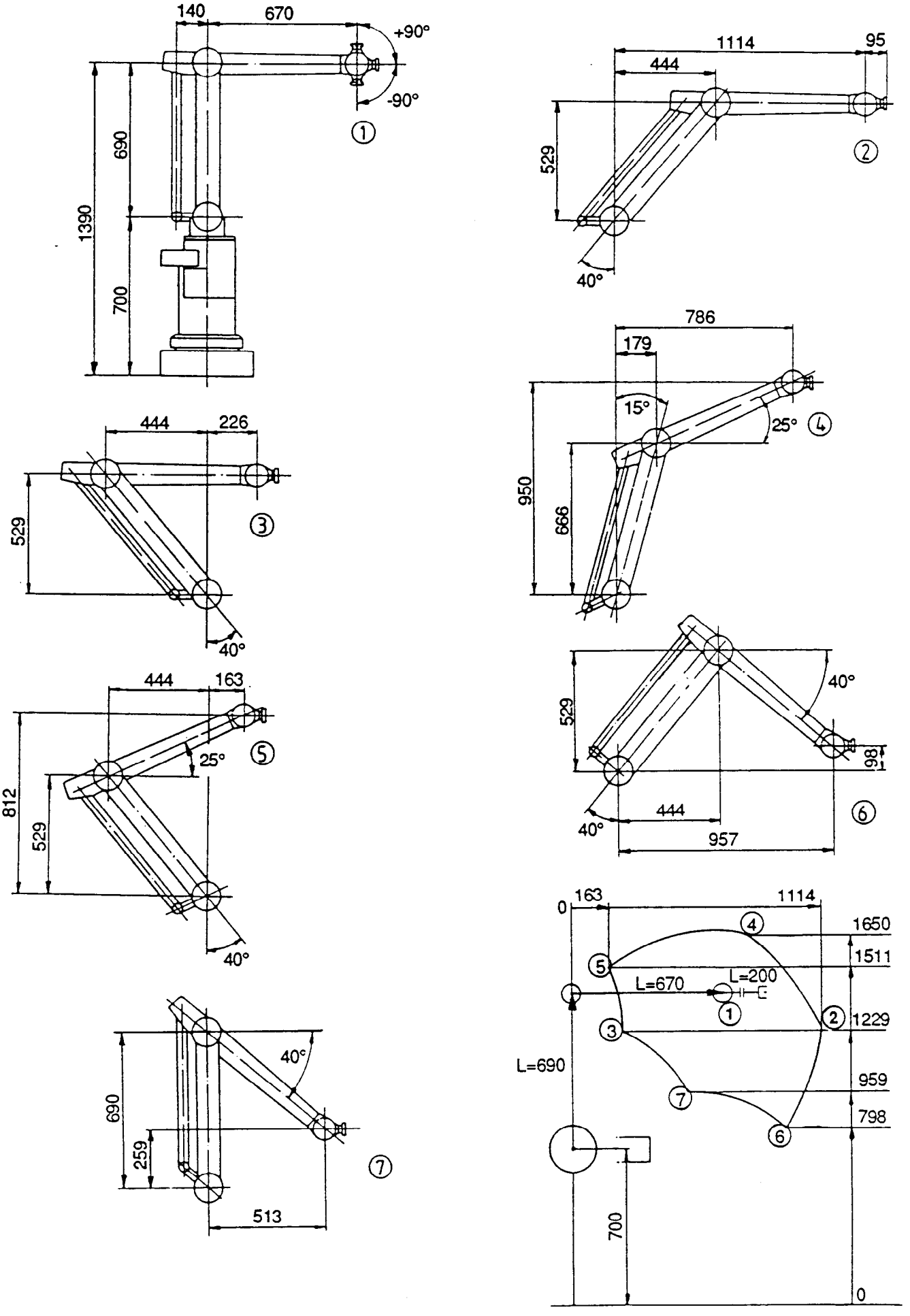




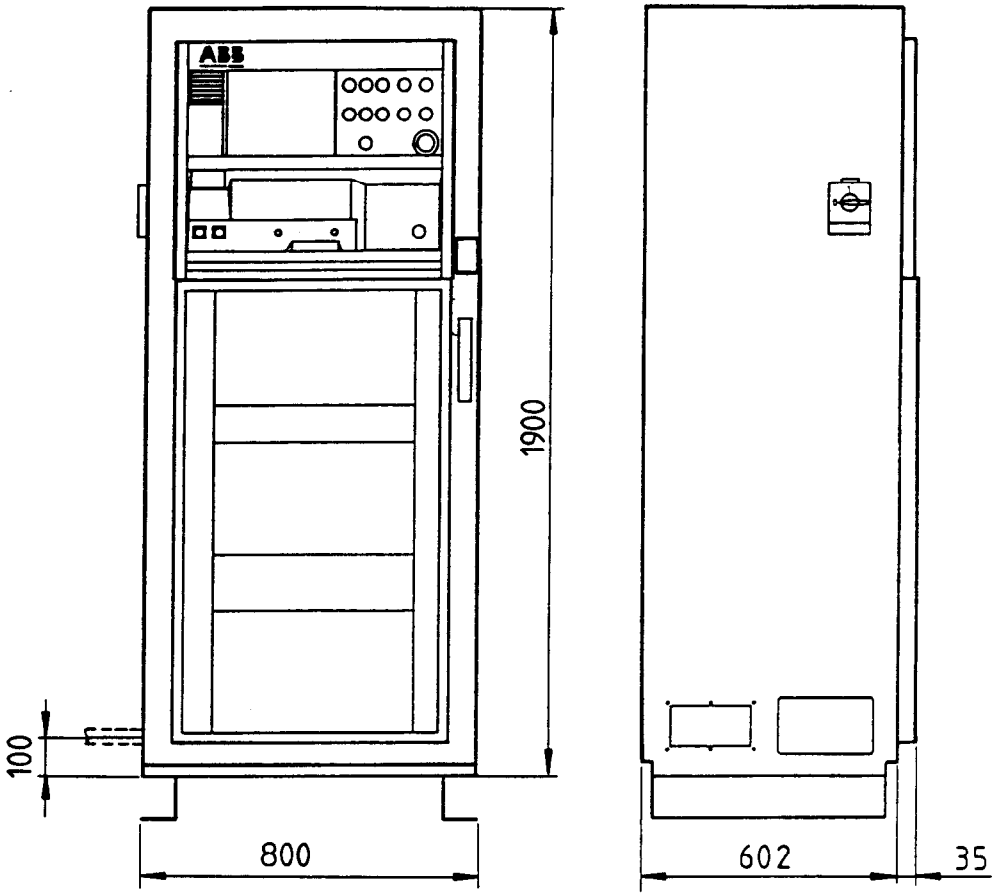


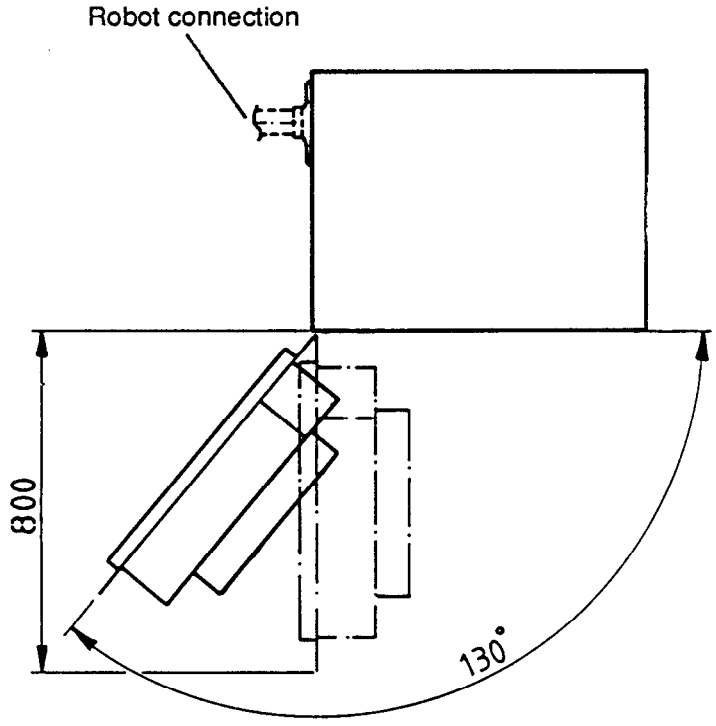


Working range with robot axes in extreme positions.

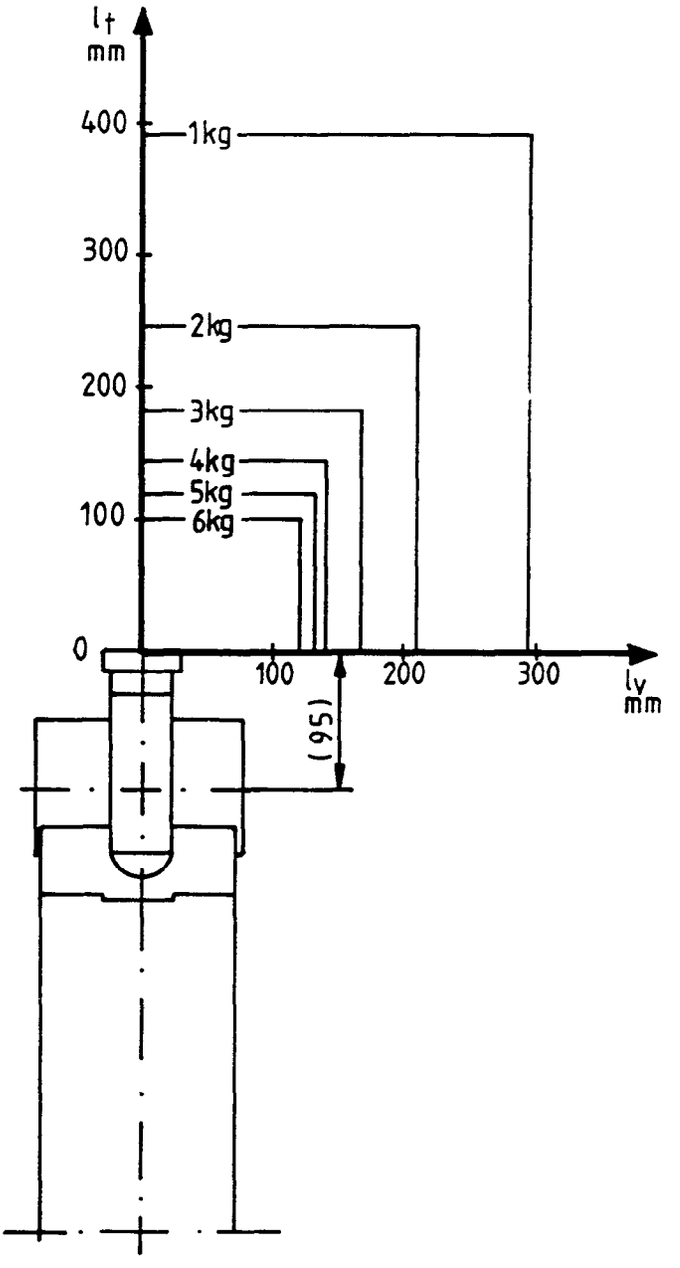


Control cabinet





Loading diagram IRB 6



Permitted load as a function of the location of the mass centre of gravity, relative to robot mounting flange.

ABB ROBOTICS AB

110-SF.1
SEROB/BPM 89-09-20

UDB.....ref. no..... OEM..... Appl. description.....

Sales eng..... End user..... .....

Appl. eng..... Location..... Rob order no.....

SPECIFICATION FORM FOR INDUSTRIAL ROBOT SYSTEM IRB L6E

7 MAINS VOLTAGE
- ☐ 380 V
- ☐ 415 V
- ☐ 440 V
- ☐ 475 V

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

10 DIGITAL INPUT/OUTPUT CAPACITY
- ☐ 10.1 Basic capacity only *1
- ☐ 10.2. Extended capacity, *2
  - ☐ 10.2.3 Type DSDX 110 qty .....

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

17 DOCUMENTATION
- ☐ 17.2 Swedish
- ☐ 17.3 English

21 PROGRAMMING LANGUAGE
- ☐ 90S.21.1 Eng, Ger, Fr, Du
- ☐ 90S.21.2 Eng, It, Sp, Po
- ☐ 90S.21.3 Eng, Jap, Fin, Swe

22 SPECIAL REQUIREMENTS
- ☐ 22.1 No
- ☐ 22.3 NA version

23 ADDITIONAL FUNCTIONS
- ☐ 23.1 No
- 23.2 Yes, one or a combination of
  - ☐ 23.2.1 Prog. print out
  - ☐ 23.2.50 Cables upper arm

24 ADDITIONAL PROGRAM FUNCTIONS
- ☐ 24.4 Computer link, *4

- ☐ **115 EXTENDED MEMORY**

- ☐ **250 KIT FOR LIMITED WORKINGRANGE**

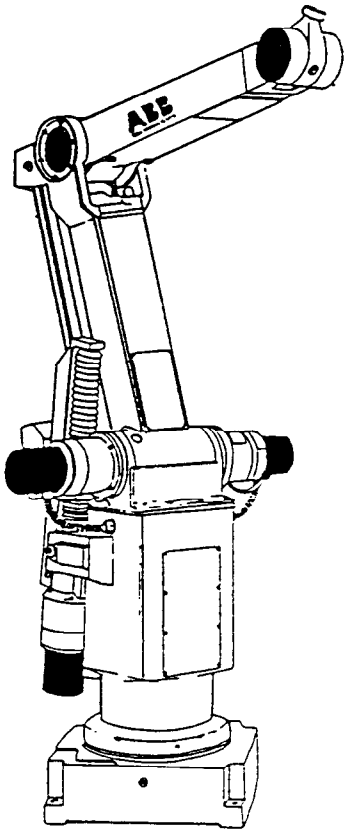
For service
- ☐ 500 TEST ADAPTER
- ☐ 530 EXTENSION BOARD, 64 POLE
- ☐ 531 EXTENSION BOARD, 28 POLE

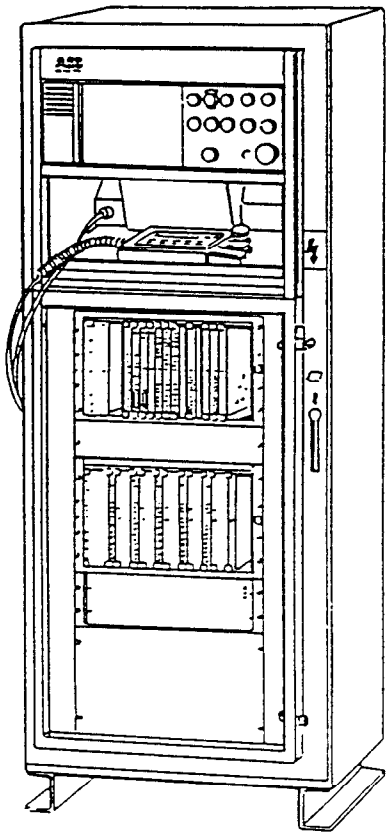
Pre specified for IRB L6E
- Cable length between Robot-Control Cabinet is 10m.
- Control Panel is located in Control Cabinet.
- Compartment for programming unit is located in Control Cabinet.
- Cable connection to Control Cabinet at left side of the Cabinet.
- Brakes on all axis.
- Added program functions included.
- Adaptive control included. *3
- Length of cable for programming unit is 10m.
- Floppy disc unit included.
- Inspection window on Control Cabinet.
- 2 digital I/O included.
- 2 analog outputs included (system I/O).

---

*1) Accessible inputs/outputs.
8 general outputs 4 general inputs,
2 gripper outputs,
5 outputs and inputs predefined for AW or common drive functions. 5 outputs and 7 inputs of the predefined AW/common drive I/O's can also be used as general I/O's.
*2) Up to three input/output units can be selected (10.2).
*3) Requires cables upper arm (23.2.50) if sensors are to be mounted on robot.
Includes 3D frame function.
*4) Requires Program print out (23.2.1).

Installation
IRB L6E





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ASEA BROWN BOVERI

Article number: 6397 014-304
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ABB Robotics AB
S-721 68 Västerås
Sweden

CONTENTS Page

1
INTRODUCTION

This manual describes the installation and preparation for operation of the robot system and includes the following information:

- Safety precautions
- Electrical connection of all signals to and from the control equipment
- Mechanical installation of equipment
- Connection methods and cable selection
- Reference to the following drawings/documents (not included):

Circuit diagrams IRB L6E	6397 015-128
Description IRB L6E	6397 012-303
Service manual IRB L6E	6397 020-127
Programming manual S2	6397 013-115

IMPORTANT

Prior to start of unpacking/installation, please read the safety precautions and follow instructions given in Chapter 2.

2
SAFETY PRECAUTIONS

2.1
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 the same respect as other machines and tools.

Observe that:

- The maximum 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 acceleration and braking.

2.2
Personnel safety

2.2.1
Integrated functions

- Emergency stop buttons on control cabinet and programming unit.
- "Safety pad" when operating with the joystick.
- Limitation of positioning speed with programmed running if the programming unit is used outside of its compartment.
- Synchronisation impossible if the programming unit is removed from its compartment.
- Overspeed supervision (Only when the programming unit is not in its compartment).
- Resolver supervision.
- Connection terminals for coordination of the emergency stop systems of the robot and the peripheral equipment.

2.2.2
Safety procedures during installation

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

- Surround the working range of the robot with a guard rail and install gates with limit switches in series with the emergency stop to stop the robot and the peripheral equipment when a gate is opened (see Chapter 7.9).
- 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 Chapter 7.4.2).

- 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 Chapter 7.4.2.). Remember that the robot requires a certain braking distance.

- 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 conditional WAIT function via a digital input to the control system (see Programming Manual).

2.2.3
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 as far as possible 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 one is connected.

  d) If possible, have an assistant located outside the guard rail, prepared to stop the equipment in the event of an accident.

  e) Be prepared for your own mistakes during work inside the guard rail.

2.3
Operational safety

2.3.1
Integrated supervision functions

The following supervision functions are built into the system:

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

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

2.3.2
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 11).

- 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 for supervising the robot system operation.

- Check limit switches.

Remember in particular that an alarm should be generated if the emergency stop is activated. Utilize if possible, the ERROR output for alarm and the direct inputs for jump to subprogram 1-5 (see Chapter 7.2.3.).

2.3.3
Procedures when operating

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

- Include supervision of the robot operation in all programs where 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 before start-up that:

- The robot installation is undamaged

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

3
UNPACKING AND HANDLING

After the robot and auxiliary equipment has been unpacked, check that no external damage has been caused to the equipment during transit/unpacking. Ensure that all electrical contacts and circuit boards are properly inserted, check that all the function units in the control cabinet are fixed securely.

If the field connections cannot be started immediately, all the equipment should be stored in a weather-proof, dust free environment within a temperature range of +0° C to +50° C.

3.1
Lifting details

3.1.1
Lifting the robot with hoisting crane

Total weight of the robot is 145 kg. Brakes on all axes is standard.

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 3-1)

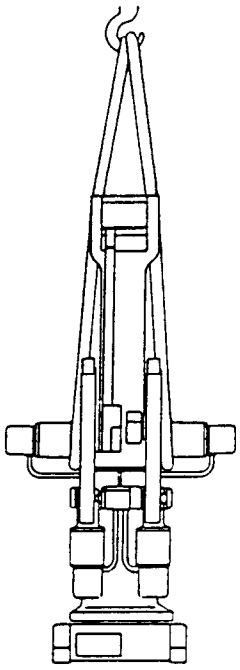


Figure 3-1

3.1.2
Lifting a suspended robot

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

Proceed as follows:

1. Raise the robot a bit with straps wound around the motors, see Figure 3-1 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 3-2).

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.

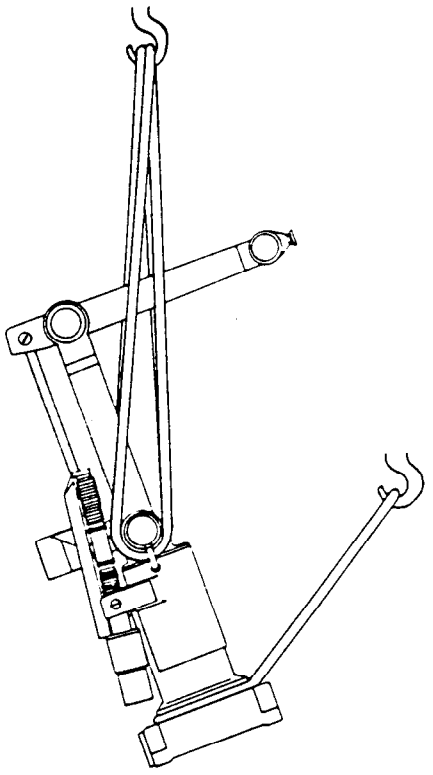


Figure 3-2

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.

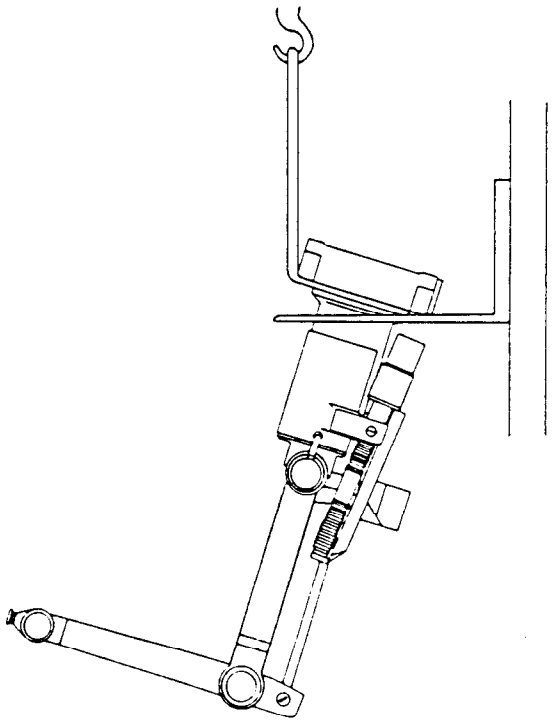


Figure 3-3

8. Lower the robot or raise the fork lift until the robot base is suspended on the fork and the strap hangs loose. The fork can either fit on the robot body (Figure 3-4) or the robot base (Figure 3-5).

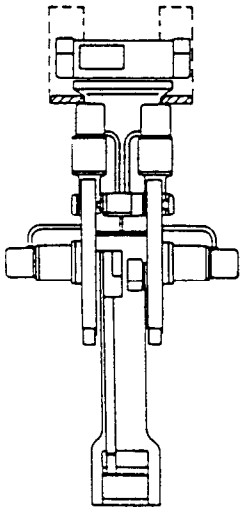


Figure 3-4

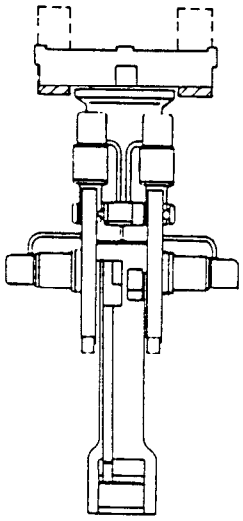


Figure 3-5

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.

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.

3.1.3
Lifting the control cabinet

The control cabinet can be lifted with a fork lift, see Figure 3-6.

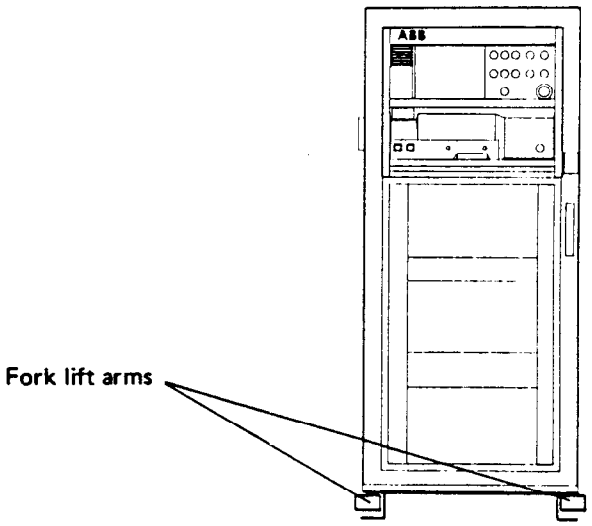


Figure 3-6

3.2
Robot and control cabinet environment

The robot has been designed and built to withstand normal environmental conditions, but its mechanical parts should be protected from corrosive fluids (e.g. coolant) and abrasive dust particles.

Temperature table

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	20 - 80 %
Protection class	IP 54

Mechanical robot:

Ambient temperature	
Motors	+5° C - +50° C
Upper arm and wrist	+5° C - +80° C
Relative humidity	20-80 %

*) 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 sensor in the cabinet disconnects voltage to the control system if the temperature limit is exceeded.

4.1.1
Mechanical robot

The surface on which the robot is to be mounted is to be in 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 4-1.

N.B. Expander bolts are suitable for this purpose.

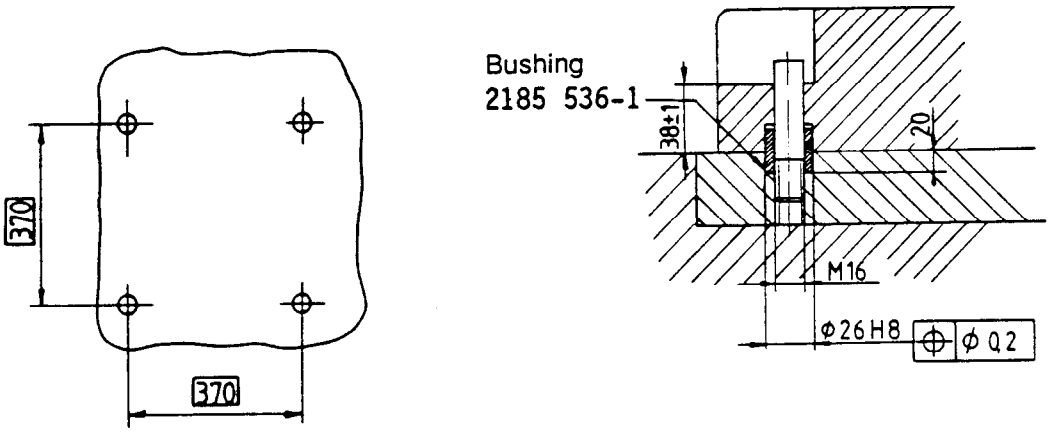


Figure 4-1

The required space and the working range of the mechanical robot are shown in Figure 4-2.

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.

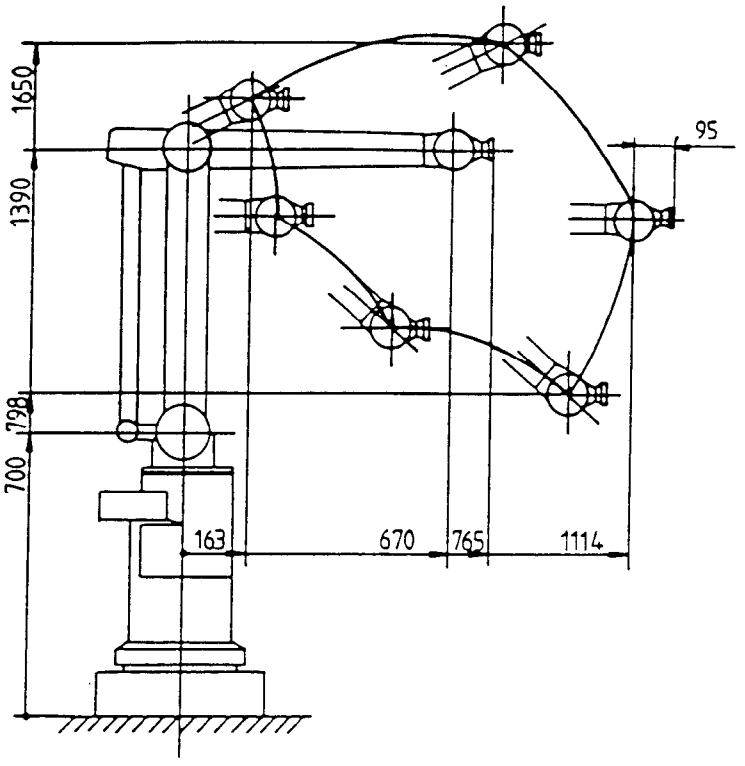


Figure 4-2

4.3
Control cabinet

Check that the control cabinet and the robot have the same serial number.

Prior to installing the control cabinet, ensure that at least 10 cm free space will be left around the cabinet in its final installed position to allow good heat dissipation. Provision must also be made to allow the front door of the cabinet to open at least 90°, to allow for access during servicing, see Figure 4:3.

The control cabinet is delivered with access for external wiring located on the bottom left hand side.

Programming unit compartment and control panel

These are installed in the front door of the control cabinet.

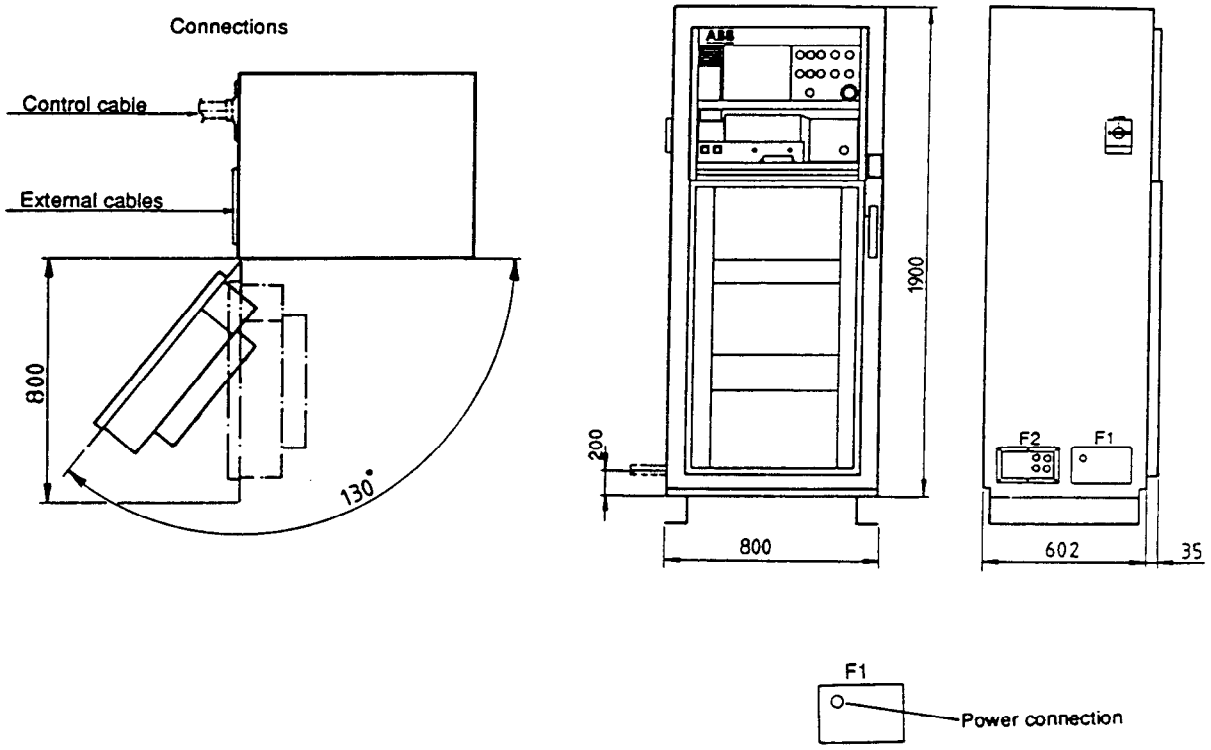


Figure 4:3

5
RECOMMENDED CABLE TYPES

All mains voltage and signal cables in the cabinet should remain unaffected with a temperature range up to 70° C.

Mains voltage cable

The mains voltage wiring must comply with the standards issued by the relevant authorities in the country in which the equipment is to be installed. The connection to the terminal block in the control cabinet permits the use of conductors with an area up to 6 mm^2. Power consumption max 6.3 kVA.

Signal cables

The signal cables should normally be of screened type, this is especially valid for measurement transducer signals for external axis and analog signals.

Signals for digital inputs/outputs, emergency stop etc. need not be screened unless routed near wiring generating considerable interference.

The signal cables must have conductor areas greater than 0.25 mm^2. The maximum conductor area for terminal block connections is 2.5 mm^2.

Recommended cables:

Number of conductors	Conductor area min. mm^2	External diameter mm	Screen	Cat. No.	Recommended function
4	2.50	11.0	-	1686 0022 -31	Mains voltage
4	4.00	13.0	-	-32	"
3 x 2	0.25	7.5	Yes	1683 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	"
5	1.50	13.0	-	1686 0039 -01	Motor cable

Maximum cable lengths between control cabinet and

Mechanical robot	10 m
Digital and analog inputs/outputs	30 m

6
INTERFERENCE SUPPRESSION

6.1
General

The wiring should be divided into two groups.

1) Those that generate interference:

   Operating signals ≥ 60 V.
   Power and motor signals.

2) Those that are sensitive to interference:

   Operating signals < 60 V. Measurement transducer signals, digital signals, etc. These cables should not be routed parallel with interference generating cables with less separation than 30 cm. Certain measurement transducer signals are to be provided with a screened conductor as described in chapter 5.

6.2
Interference protection

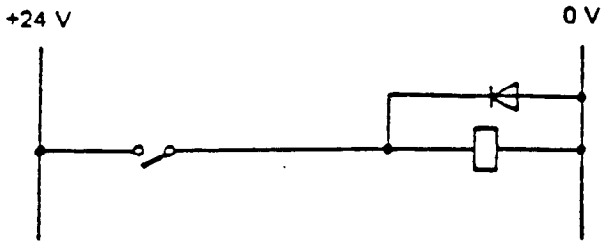
Relay coils and other elements in the control system are suppressed so that their operation does not cause interference in the electronics.

Relay coils, solenoid coils and motors outside the cabinet should be suppressed in a corresponding manner. Figure 6:1 illustrates examples of this.

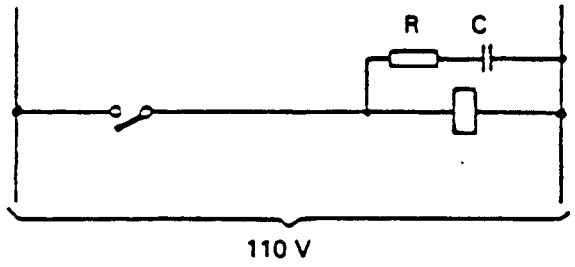
Note that the switch-off time of a relay increases when a diode is connected across the coil.

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

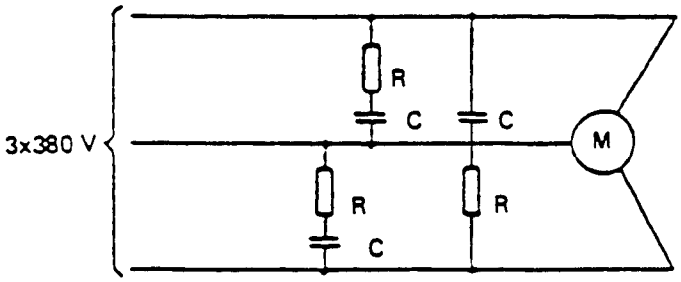
Suppression of coils also increases the service life of the contacts which control the coils.



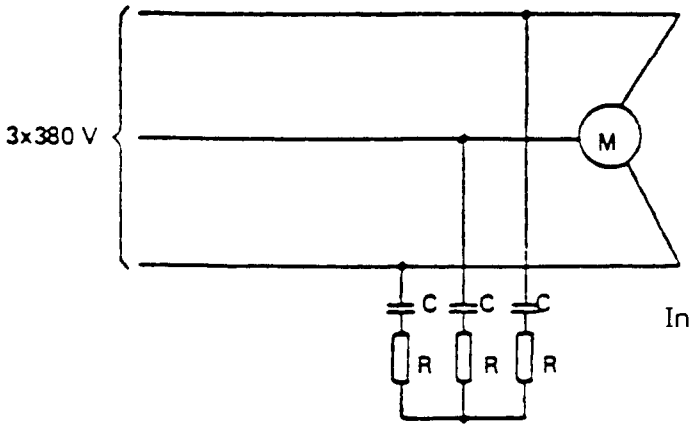
The diode is dimensioned for the same current as the relay coil and double the operation voltage.



R 100 ohm, 1 W
C 0.1-1 uF
≥ 500 V max voltage
125 V rated voltage



R 100 ohm, 2 W
C 0.5 uF
≥ 1000 V max voltage
> 420 V rated voltage



R 100 ohm, 1 W
C 0.5 uF
> 1000 V max voltage
> 250 V rated voltage

Interference protection

Figure 6:1

7
CONNECTIONS AND SIGNAL DESCRIPTION

7.1
Connections and routing of cables

7.1.1
General

The control cabinet is provided with a compartment for the programming unit. See Figure 7:1. The programming unit is connected to the control unit via a plug.

The programming unit must not be connected or disconnected if the control system is in standby or operation.

At the lower left side of the control cabinet, two outputs F1 and F2 are provided for external wiring. See Figure 7:1.

The control cable to the mechanical robot is connected to F2 via cable glands.

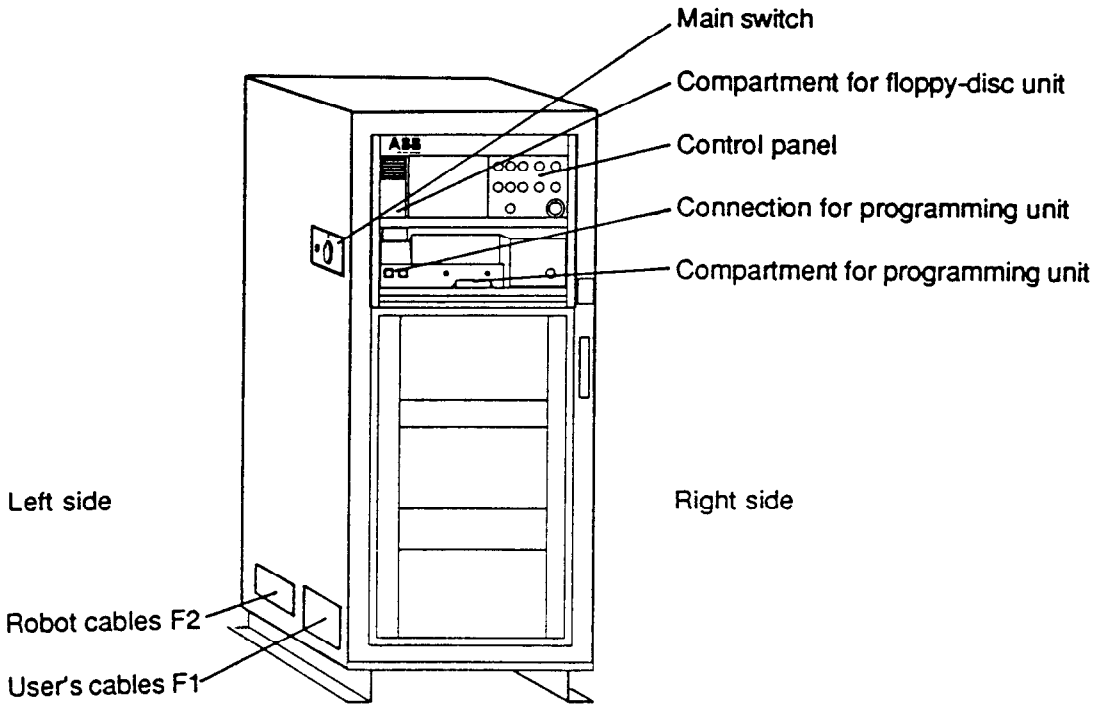


Figure 7:1

A cover plate is fixed at F1 for access through cable glands of other cables including the mains connections. See chapter 7.1.3.

The cables are connected to terminal blocks in the control cabinet with the exception of those for robot control, for which multi-pole contacts are used.

The locations of the terminal blocks and contacts are indicated on the inside of the door. See also Figure 7:2.

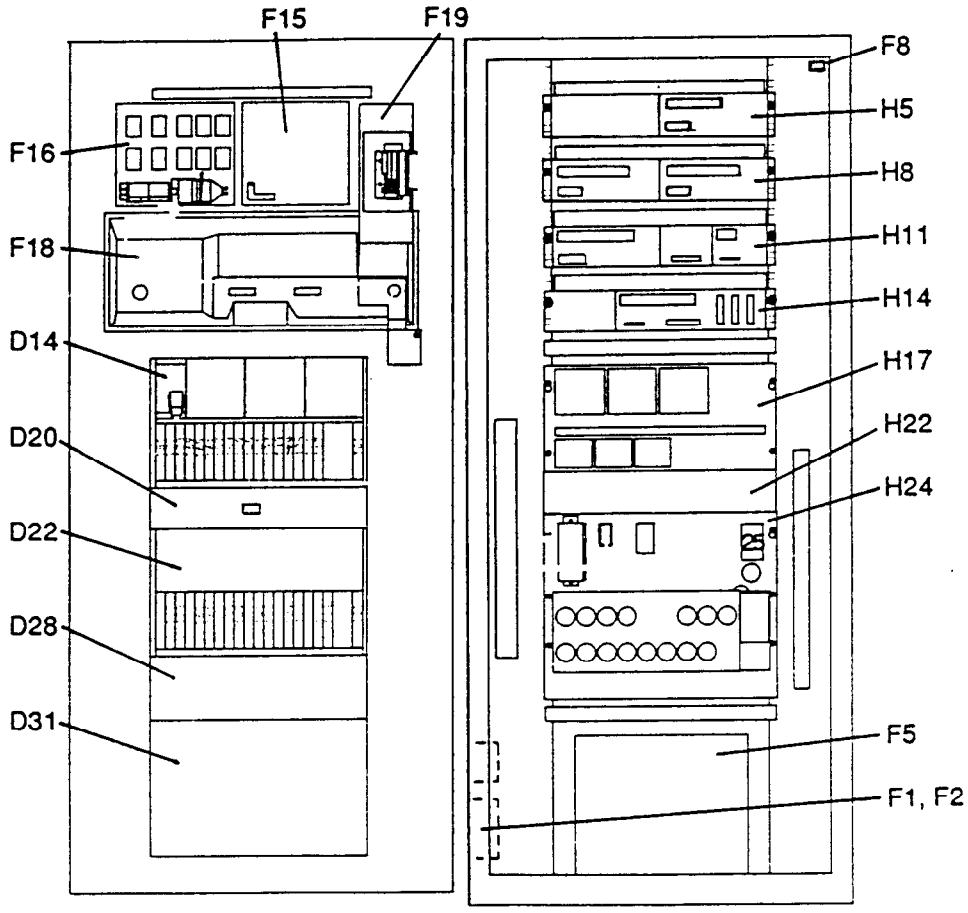


Figure 7:2

The control cable is connected at the foot of the robot as shown in Figure 7:3. All connections to the mechanical robot, including customer connections, are transmitted via the control cables from the control cabinet.

7.1.2
Cable routing

Cables from the exterior must be located in the cable duct at the right hand side of the cabinet. Connections to the power unit (H24) must be routed in the cable duct. See Figure 7.4.

When installing cables, the recommendations for interference protection as described in chapter 6 are to be followed.

7.1.3
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.

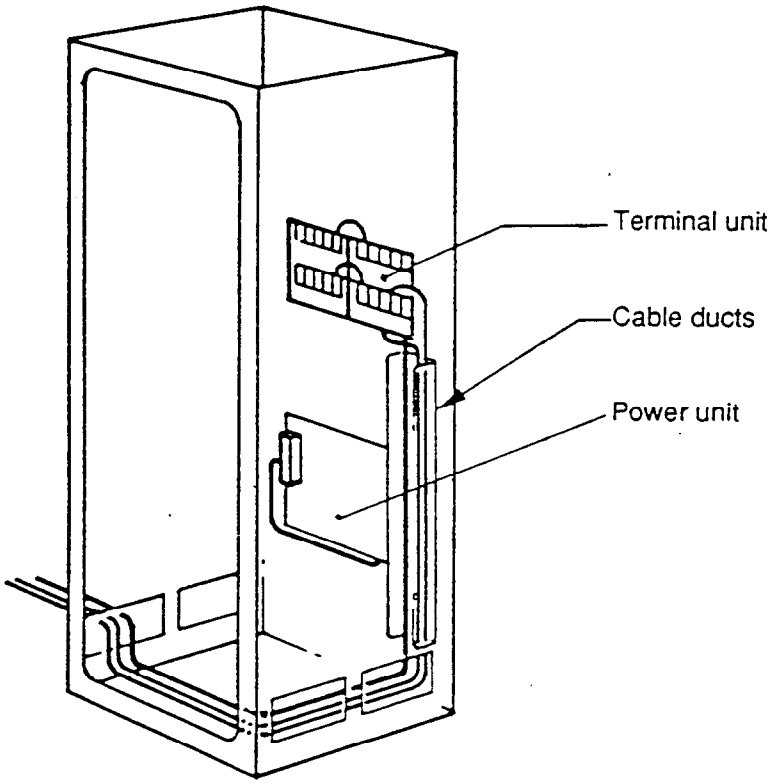


Figure 7:4

The following cable glands are available:

Cover plate F1:	1 of Ø 16 mm	Mains connections
Cover plate F2	2 of Ø 16 mm (14.5-17.5 mm)	

7.2
Digital inputs/outputs

7.2.1
General

The control system contains a basic set of 4 digital inputs and 4 digital outputs on 24 V DC channels.

The in- and outputs are connected to a terminal unit. At delivery, the terminal unit is provided with two jumpers, W1 and W2. The digital in- an outputs are then supplied with internal 24 V supply. The in- and outputs are then not galvanically separated from the robot system.

If the jumpers W1 and W2 are removed the digital in- and outputs becomes galvanically separated from the robot system and require an external 24 V supply.

The system can be provided with extra digital inputs/outputs of different types, see chapter 7.2.3.

7.2.2
Basic set of digital inputs/outputs

Basic inputs/outputs (see Figure 7:5) are connected at the terminal unit D14.153 in the rear wall of the control cabinet H14. (Note the terminal unit has the same item designation as the associated digital board in the rack D14.

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 signal connection to the mechanical robot, see chapter 7.5.

GRIP/RELEASE 3 - 8

N.B! When a multiple gripper is used, more GRIP/RELEASE-positions are supplied from the outputs. This is done by programming the function parameters, see section 11.2.1. Certain outputs are then reserved for the grippers as follows:

GRIP/RELEASE	OUTPUT
1	-
2	-
3	1
4	2
5	3
6	4

If there are extra I/O-boards with outputs, the GRIP/RELEASE 3 - 8 have outputs 7 - 12 instead. Hence, if an output is to be used, always check that it is not reserved for grippers. A check is also to be done at the programming of an output.

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

The outputs can be used as a four bit port. The value (0-15) in a register is transmitted in binary form to the outputs.

Port I	output 1	least significant bit
	output 2	
	output 3	
	output 4	most significant bit

If the outputs are to control relays, these are to be suppressed as described in chapter 6.

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

The inputs can be used as a four bit port. The status of the inputs is then interpretated as a binary value (0-15) which is transmitted to a register.

Port II	input 1	least significant bit
	input 2	
	input 3	
	input 4	most significant bit

If the inputs are to be controlled via contacts or transistors, these are to be dimensioned for 32 V and 10 mA.

Outputs number 5 and 6 and inputs number 5, 6 and 7 are reserved for internal signals.

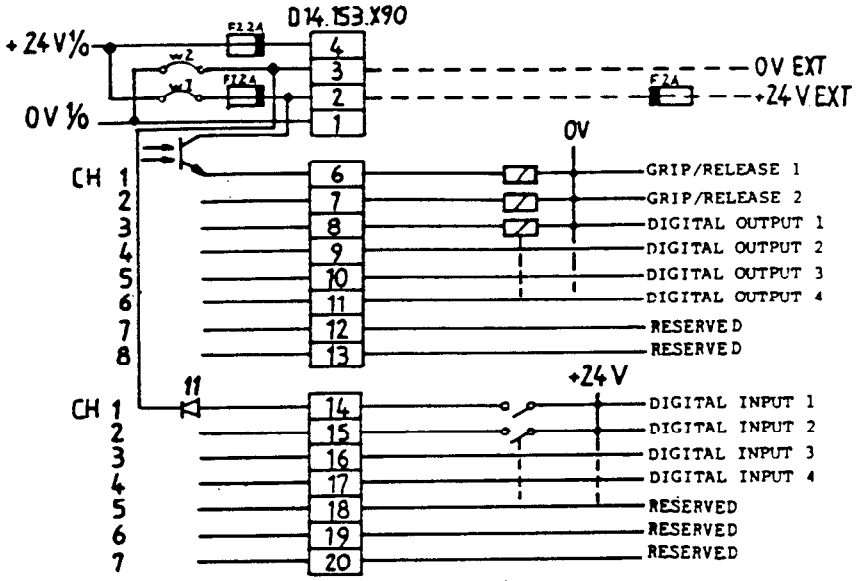
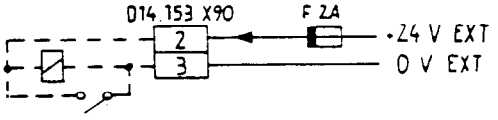


Figure 7:5

When the straps W1 and W2 have been disconnected, the terminals are used for external 24 V supply of the basic set of in/outputs. The emergency stop chain or extra digital in/outputs can also be supplied from here (see 7.2.3 resp. 7.4.2) in this case.

External 24 V-supply can not be used when the robot system is equipped with automatic restart.



Input data:	Voltage	21-32 V DC
	Rated voltage	24 V DC
	Fusing	max 2A
	Ripple	2 V p-p

Data See board type DSDX 110, Table 7-1.

7.2.3
Extra digital inputs/outputs

Reference drawings

System circuit diagram for:

1) Terminal numbers for connection unit
2) Fusing on the connection unit
3) Connection of supply on the connection 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-H5, and an input/output board located in the rack D14. (Note that the connection 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 7-1.

The type of input/output board fitted (see table 7-1) at the different places in the Figure 7:6 must be defined with function parameters according to chapter 11.

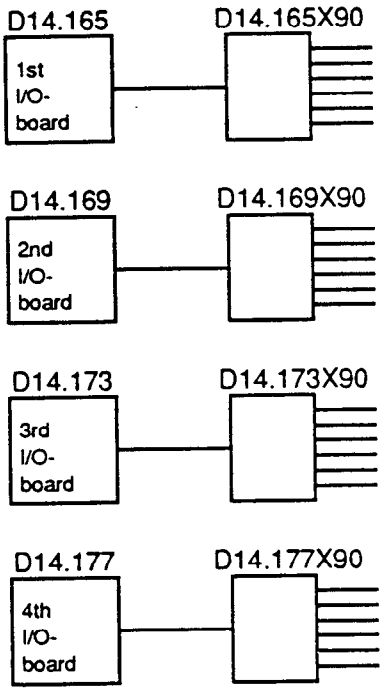


Figure 7:6

Table 7-1 Data, digital input/output board

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

1) The outputs are not short-circuit protected.

The extra inputs/outputs are normally supplied from an external voltage source. Internal 24 V DC-supply can also be used (see chapter 7.4.3).

For connection of supply, see system circuit diagram and table 7-1.

Descriptions of signal functions at all input/output channels obtained at the extra input/output units are as follows. For plint 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 program execution progress. 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 according to basic I/O.
CH 6	GRIP/RELEASE 2 Duplicated function according to basic I/O.
CH 7	SEARCH STOP The signal is active when search stop occurs with adaptive searching. It is deactivated when a new search instruction is programmed.
CH 8	DIGITAL OUTPUT 7 or GRIP/RELEASE 3
CH 9	DIGITAL OUTPUT 8 or GRIP/RELEASE 4
CH 10	DIGITAL OUTPUT 9 or GRIP/RELEASE 5
CH 11	DIGITAL OUTPUT 10 or GRIP/RELEASE 6
CH 12	DIGITAL OUTPUT 11 or GRIP/RELEASE 7
CH 13	DIGITAL OUTPUT 12 or GRIP/RELEASE 8
CH 14	DIGITAL OUTPUT 13
CH 15	DIGITAL OUTPUT 14
CH 16/32	DIGITAL OUTPUT 15/31

First extra digital board with input channels

CH 1 INTERRUPT INSTR *) If the input is activated, the current instruction is interrupted. The sub-sequent program execution is in accordance with one of the following alternatives:

1 If the input INTERRUPT PROGR is activated simultaneously or has been activated previously, program execution is also interrupted.

2 If the input JUMP PROG 1, 2 ... is activated simultaneously or has been activated previously, a jump is made to the first instruction of the subprogram selected.

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 PROGR *) 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.

*) 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 PERMIT INTERRUPT has been executed.

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

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.

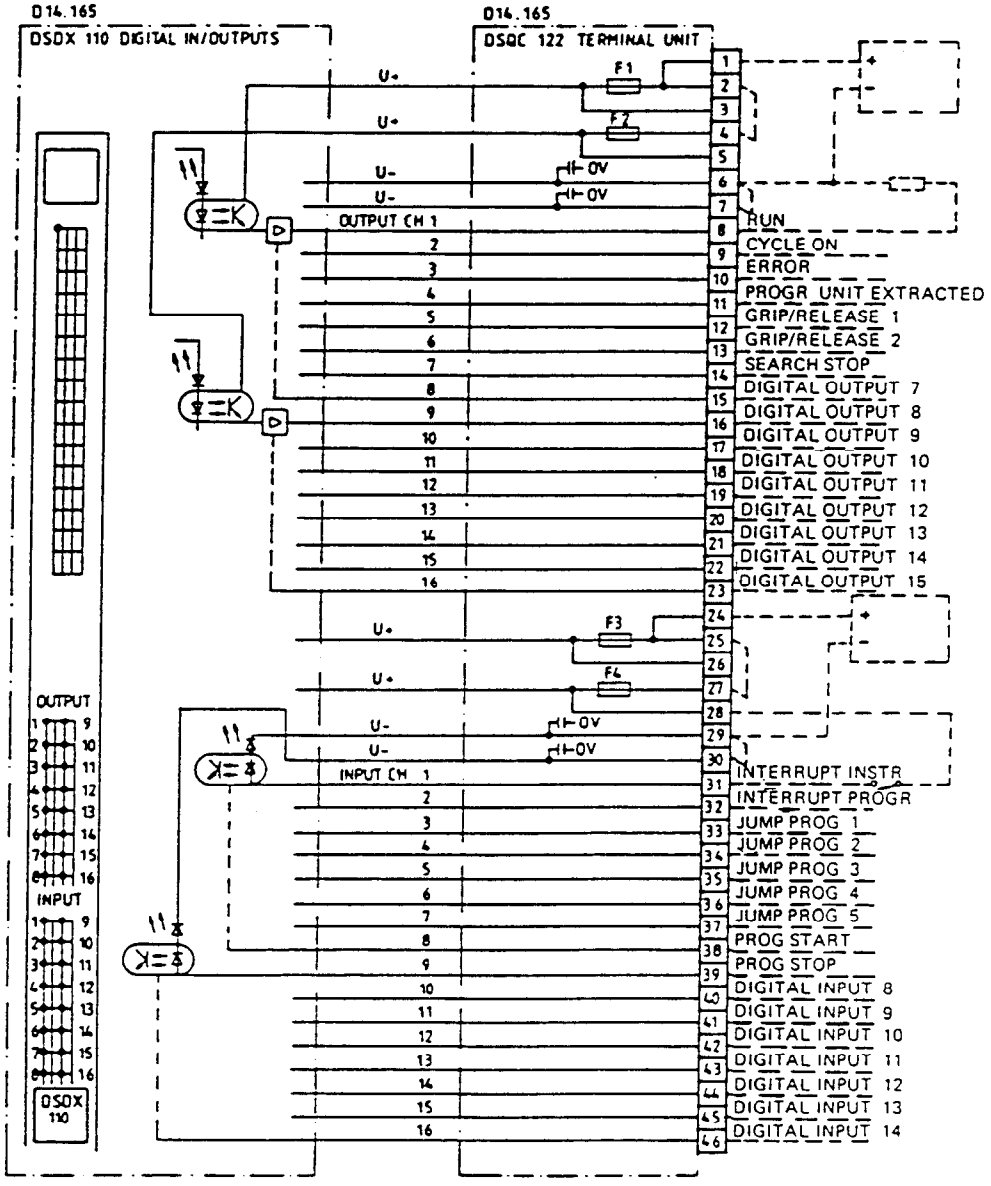
Second, Third ..... extra digital board with output channels:

CH 1	DIGITAL INPUT 15/31
CH 2	DIGITAL INPUT 16/32
CH 16/32	

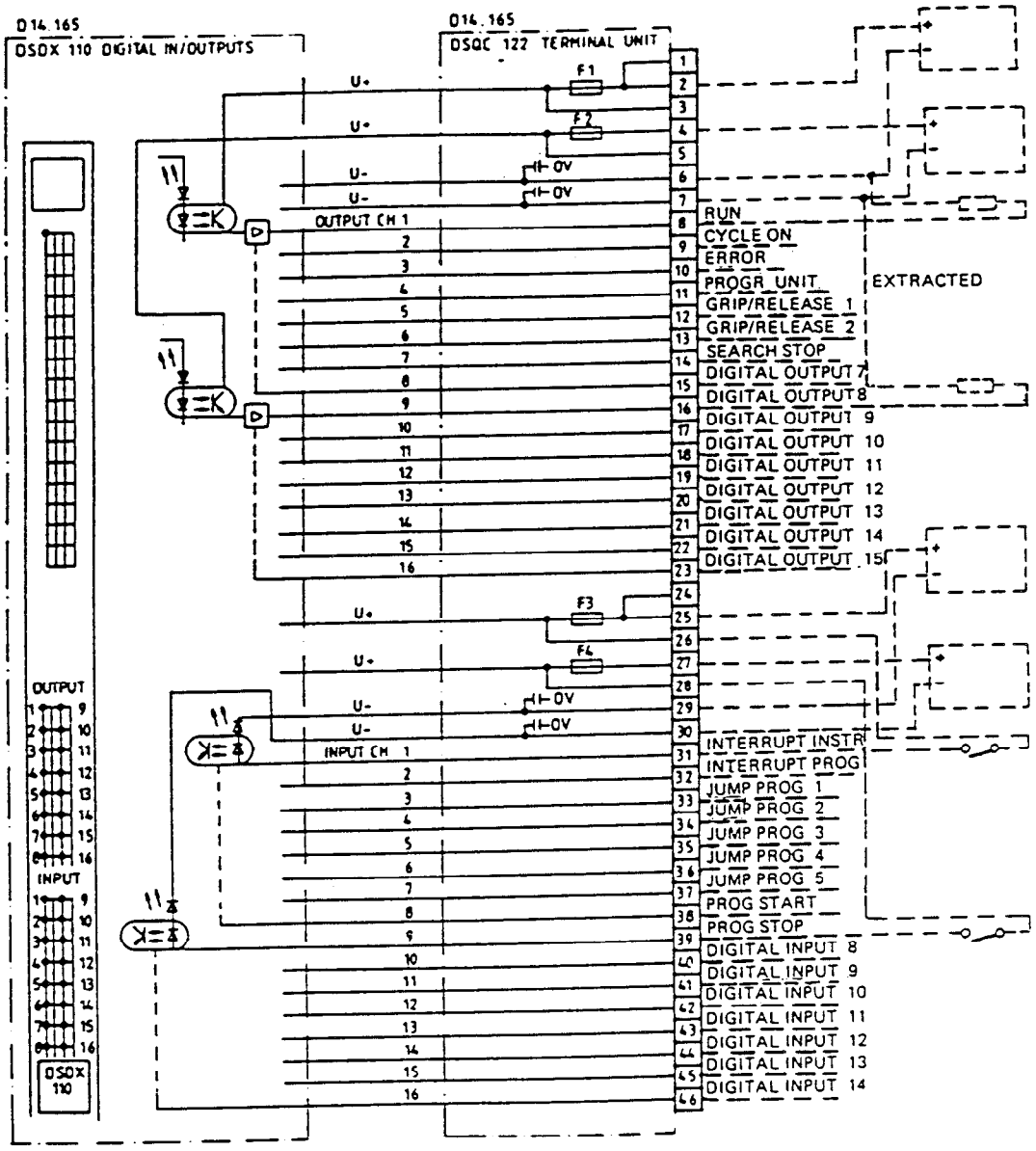
The number of inputs is increased with 16 or 32 channels for each further module.

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 figure below. (See also System Circuit Diagram).



Power supply in groups of 2 x 16 inputs/outputs



Power supply in groups of 4 x 8 inputs/outputs

7.2.4
Terminal unit for power supply

If the control cabinet has been delivered with extra terminal units for up to 220 V, these are located in the top right hand corner of the cabinet, on the side wall, see Fig. 7:7a. The terminal unit is divided in groups of 10 terminals as shown in Fig. 7:7b.

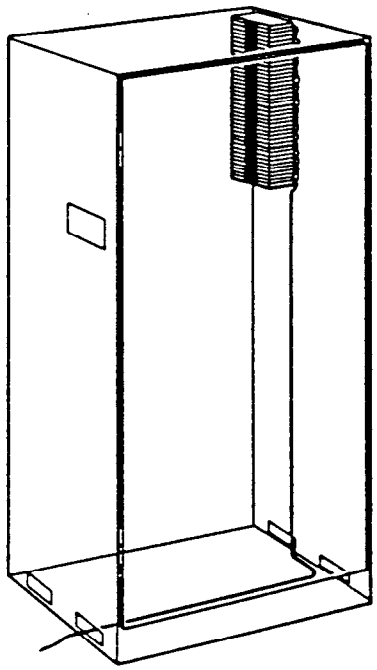


Figure 7:7a

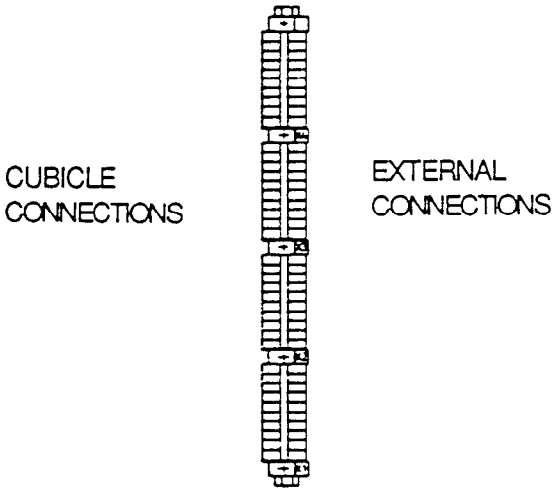


Figure 7:7b

No wires are connected to the terminals on delivery. Each terminal group can be supplied with any voltage up to 220 V, obtained from an internal or external voltage source.

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

7.3
Analog inputs and outputs

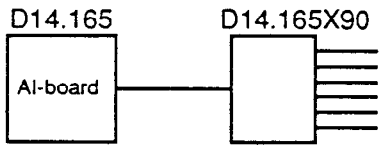
References: System circuit diagram for
1) Connection unit terminal numbering
2) Connection unit terminal fusing

The control system can be provided with:

- 32 analog inputs there of.
- 16 analog inputs for adaptive control of the robot by means of analog sensors. See section 8.1.
- 4 analog outputs for control of external equipment from internal numerical registers. See section 7.11.

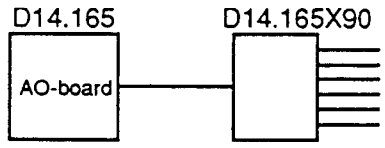
The analog boards are located in rack D14 and the associated connection units are located in the rear plane (H11 or H8) of the control cubicle. The following alternative locations can be used:

1) Without analog output board



In addition, up to 3 digital input/output boards can be included.

2) Without analog input board



In addition, up to 3 digital input/output boards can be used.

3) Both analog boards are used

In addition, up to 2 digital input/output boards can be included.

The type of analog board at the different places must be defined with the function parameters as shown in Chapter 10.

The numbering of the analog inputs and channel numbers are given below.

CH 1	ANALOG INPUT 1	(PORT 31)
CH 2	ANALOG INPUT 2	(PORT 32)
'	'	
'	'	
'	'	
CH 16	ANALOG INPUT 16	(PORT 46)
'	'	
'	'	
'	'	
CH 32	ANALOG PORT 62	

Data:

Board type:	DSAI 120
Inputs:	32 analog
Input type:	Single
Input voltage:	0 to ± 10 V
Resolution:	10 mV
Input resistance:	≥ 10^6 kohm voltage input

The analog output and channel numbering are specified below.

CH 1	ANALOG OUTPUT 1 (PORT 21)
⋮	⋮
CH 4	ANALOG OUTPUT 4 (PORT 24)

Data:

Board type:	DSAO 110
Outputs:	4 analog
Output type:	Single
Alternative signal range:	Voltage signal 0 - ± 10 V. Resolution 5 mV. (R > 500 ohm) Current signal 0 - ± 20 mA. Resolution 10 µA. (R ≤ 450 ohm)

On delivery, the board is strapped for voltage signals on all channels. A change to current signal is performed by restrapping the circuit board for the channel concerned. See the System circuit diagram.

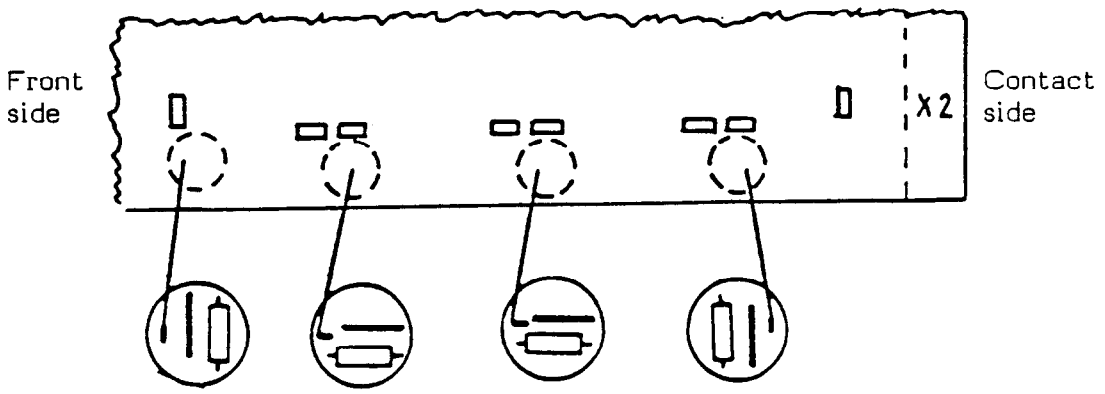
A third signal range is available:

Current signal 0 - ± 10 mA. Resolution 5 µA. (R ≤ 900 ohm).

For this:

1) The channel concerned must be restrapped as a current signal. See the System circuit diagram.

2) Remove the straps, as necessary, using a soldering iron.



Solder strap channel 4	Solder strap channel 3	Solder strap channel 2	Solder strap channel 1

7.4
Various signal connections in the control cabinet

7.4.1
General

The terminals available to the user in the control cabinet, in addition to digital and analog signal connections are shown in Figure 7:8.

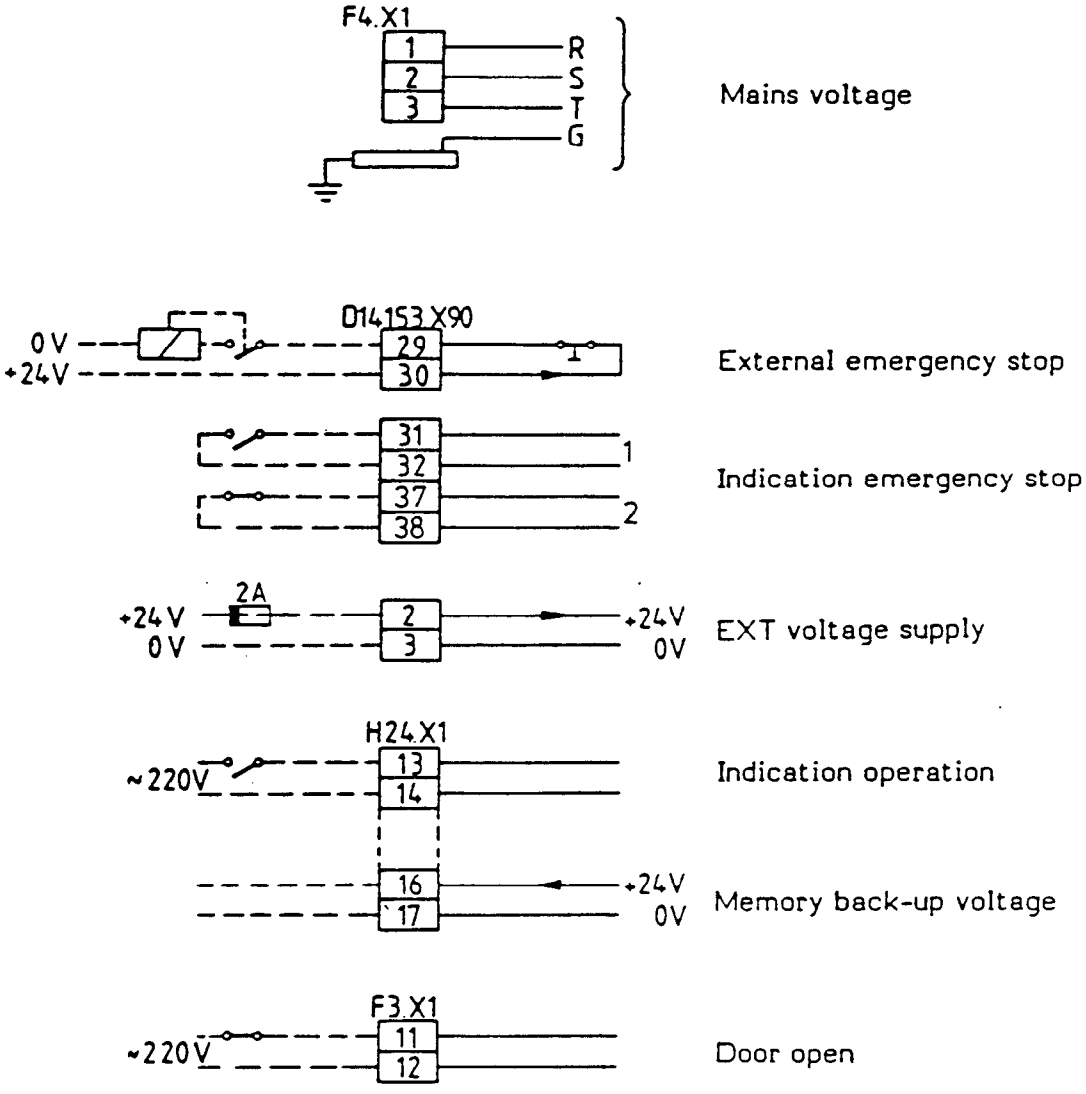


Figure 7:8

7.4.2
Emergency stop connections

A contact input to trigger an emergency stop and a contact output to indicate that the system is in an emergency stop status are provided for external emergency stop function. These are located on the distribution unit D14.153.

Contact input

Data:

Voltage	21-32 V DC
Rated voltage	24 V DC
Current	max 100 mA

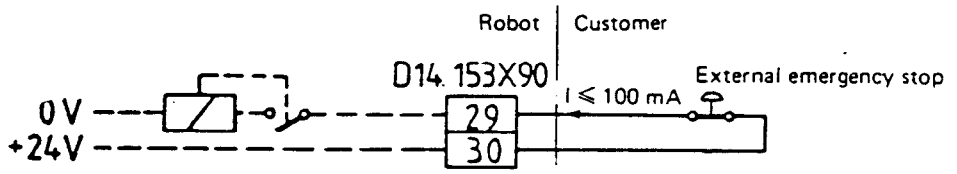


Figure 7:9a

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 resetting is performed with the OPERATION or STANDBY buttons.

Standard (not potential free) emergency stop from the emergency stop pushbutton in the control cabinet must be connected to the distribution unit D 14.153 as shown in Figure 7:9b.

Connect jumpers according to figure 7:9b.

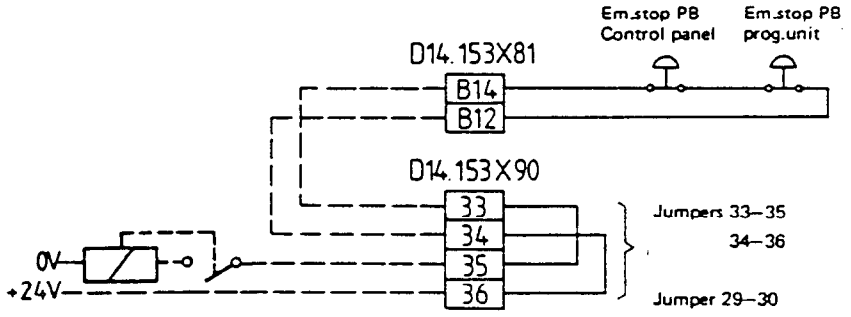


Figure 7:9b

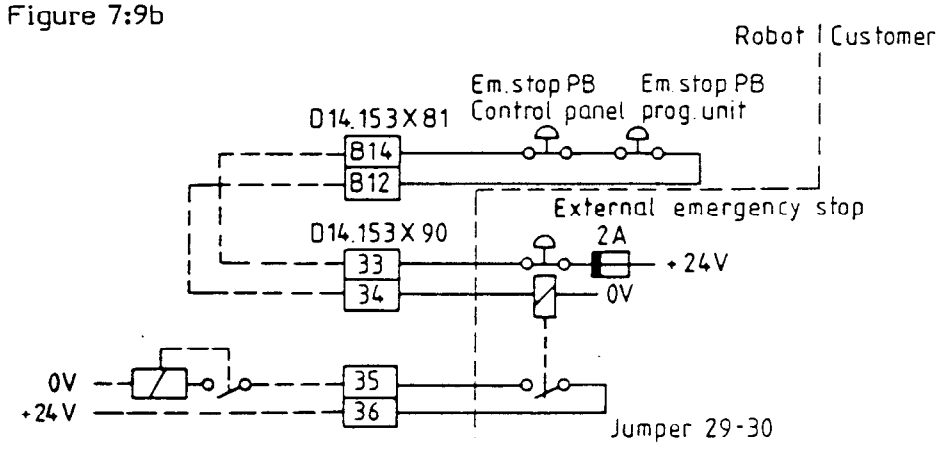


Figure 7:9c

Alternative (potential free) connection of external emergency stop and emergency stop pushbutton in the control cabinet.

If there are safety requirements which state that two or more robots, e.g in a process line, must be able to be stopped from one emergency stop pushbutton, a potential-free emergency stop scheme must be used, as shown in Figure 7:9c. (This is because the 24 V DC control voltages may not be interconnected between robots.)

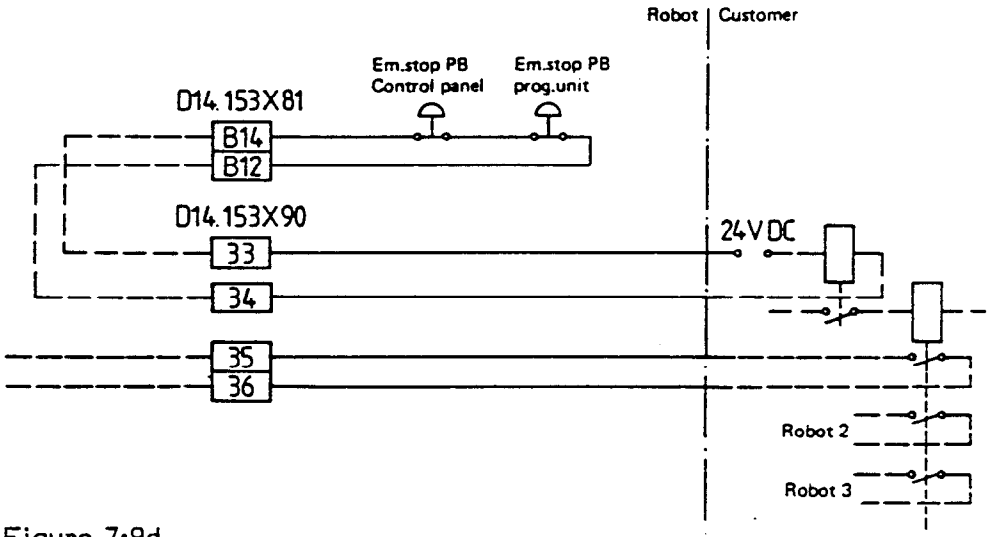
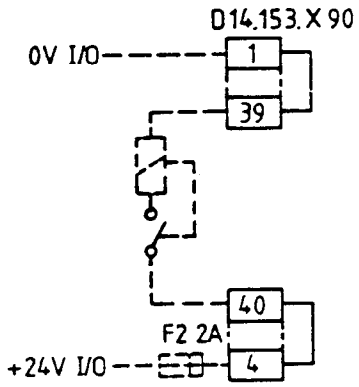
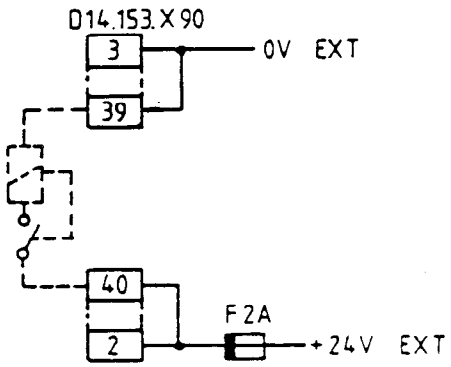


Figure 7:9d

Internal 24 V supply



External 24 V supply (if the strops W1 and W2 are disconnected)



Contact output 1:

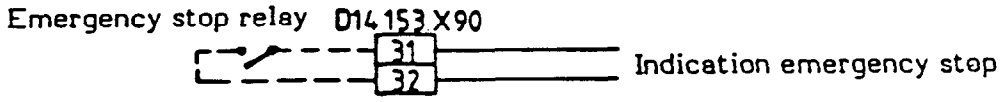


Figure 7:10a

The contact is normally closed and opens 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

Contact output 2:

The contact is normally opened and closes when an emergency stop is triggered.

Data; equal to data for output 1.

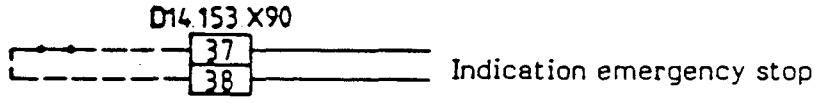


Figure 7:10b

7.4.3
Voltage supply for optional connection

+24 V DC unregulated voltage is available in the control cabinet at the distribution unit D14.153. The connection can be used either for external use or to supply extra digital inputs/outputs (see chapter 7.2.3).

Data:

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

Figure 7:11

7.4.4
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 normally 1500 hours after a power failure.

Figure 7:12

An 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.

Data:

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

7.4.5
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 chapter 7.2.3.

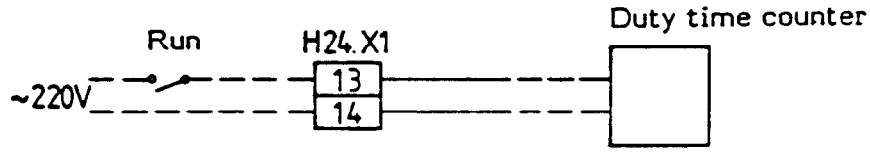


Figure 7:13

Data:

Voltage	220 V AC
Loading	max 30 VA

7.4.6
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.

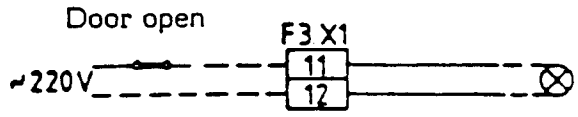


Figure 7:14

Data:

Voltage	220 V AC
Loading	max 60 VA

7.4.7
Service socket

A double 220 V service socket with a separate switch is located inside the control cabinet for supplying test and service equipment.

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

The voltage is normally available at the service socket when the main switch and safety switch are "ON".

If this service socket is to be connected externaly so that voltage is available independently of the main switch, the existing cable to the fuse/main switch must be disconnected and 220 V is to be connected from an external supply. Alternative connections are possible, see Figure 7:15.

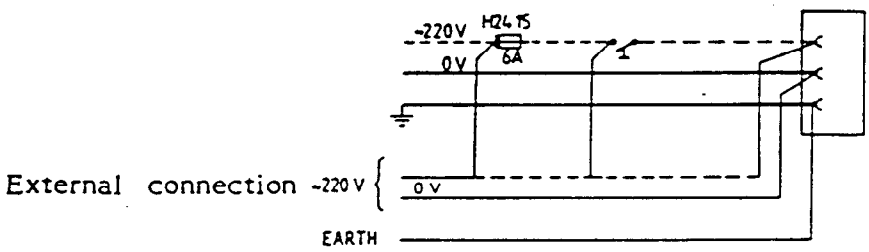


Figure 7:15

Note: The zero conductor in the external supply must have the same potential as the control cabinet earth. The zero conductor must be connected to the 0 V in the service socket.

7.5
Signal connections to robot

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 Circuit diagram, sheet 6. Such signals can be for example, signals to and from grippers, or from sensors on the robot.

Eight of these signal cables are accessible in the control cabinet at the terminal unit (D14.153) terminal blocks and they may be connected to the control equipment with leads to the I/O terminal block required. Load capacity 60 V, 700 mA. The location of the contact on the robot is shown in Circuit diagram, sheet 2.

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 6.

7.9 Safety unit

Customer connections for the working stop and safety stop functions are included in the S2 system. These are located on safety unit DSQC 136 at position F12 (left-hand side wall of cabinet).

The functions are intended to cover the working range of a robot with peripherals. Contacts connected in series in the operating loop can be used to control the power supply to all machines and equipment in the working area. Any of the contacts cuts off loop, and:

- puts the robot system in the STANDBY mode with no electrical supply to the robot motors.

- cuts off the electrical supply to the motors of the peripheral equipment.

DSQC 136 is supplied internally from the robot system and has connections for the following signal functions:

- Work hold
  Open loop gives STANDBY. The safety pad of the programming unit works as a holding device. When the safety pad is pressed, this gives RUN temporarily, but when the pad is released the system returns to STANDBY.

- Safety hold
  Open loop gives STANDBY. The safety pad of the programming unit cannot give RUN.

- Connection to control peripherals
  The connection is floating and has one make and one break contact.

- Remote control of RUN
  Switching of the robot system from STANDBY to RUN can be initiated by means of an external signal.

Work hold and safety hold are used to increase personal safety in normal operation. An example is when work is being done on the robot system within the risk area, and when it is not desirable to initiate an emergency stop.

Permanent resetting to RUN is made by pushing the RUN pushbutton on the control panel of the control cabinet or from a centrally located control panel. The control panel of the robot system must therefore always be located outside the risk area of the robot. The sections below deal with the above functions in detail.

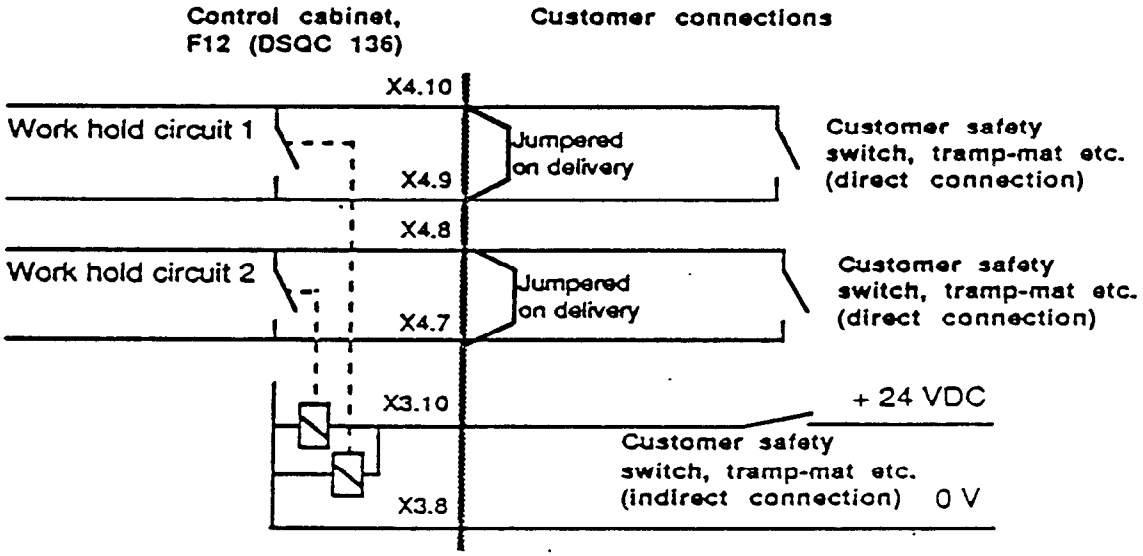
Work hold

Peripheral equipment can be connected to the internal operating loop of the robot system to initiate work hold in the robot system. When the connection is open, the RUN contactor of the robot system drops out and the electrical supply to the motors is disconnected. Connection can be direct or indirect via a relay (giving DC isolation).

In the case of direct connection, the contact must be duplicated to ensure that both connections in the system (X4.7-8 and X4.9-10) are operated.

In the case of indirect connection, the input is connected in series with the customer's loop. See diagram below.

Work hold



Technical data

Supply voltage, direct circuit	24 V DC from control cabinet
Supply voltage, indirect circuit	24 V DC external supply
Max permitted resistance in connected direct working stop loop	50 ohm
Consumption, coil in idirect circuit	15 mA

Connection table

Loop 1, direct circuit	F12.X4.9-10
Loop 2, direct circuit	F12.X4.8-7
Loops 1 and 2, indirect circuit	F12.X3.8-10

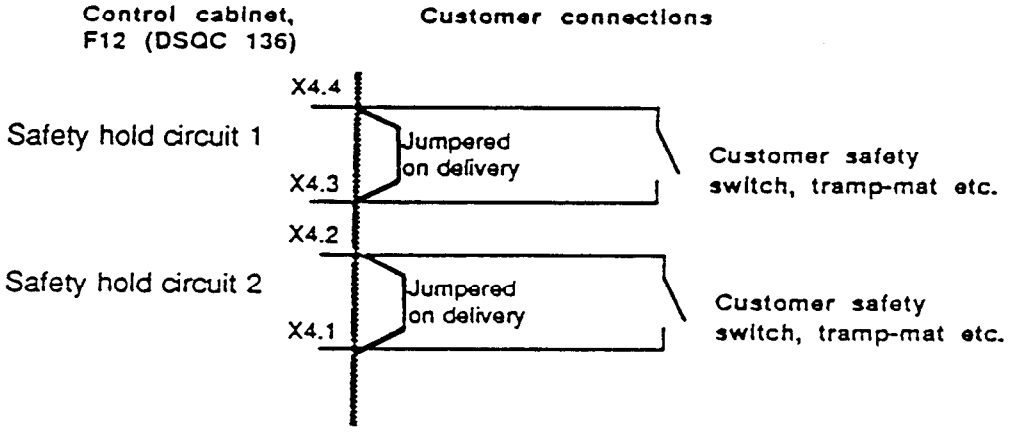
The connections above are made directly at the plug that is fitted in the relevant connector on delivery. Remove the strap and connect the cable.

Safety hold

Peripheral equipment can be connected to the internal operating loop, where it can initiate safety stops in the robot system. When the contact is open, the RUN contactor of the robot system drops out and the electrical supply to the motors is disconnected.

Both connections in the system (X4.1-2 and X4.3-4) must be operated. See diagram below.

Safety hold



Technical data

Supply voltage, direct circuit	24 V DC from control cabinet
Max permitted resistance in connected direct working stop loop	50 ohm

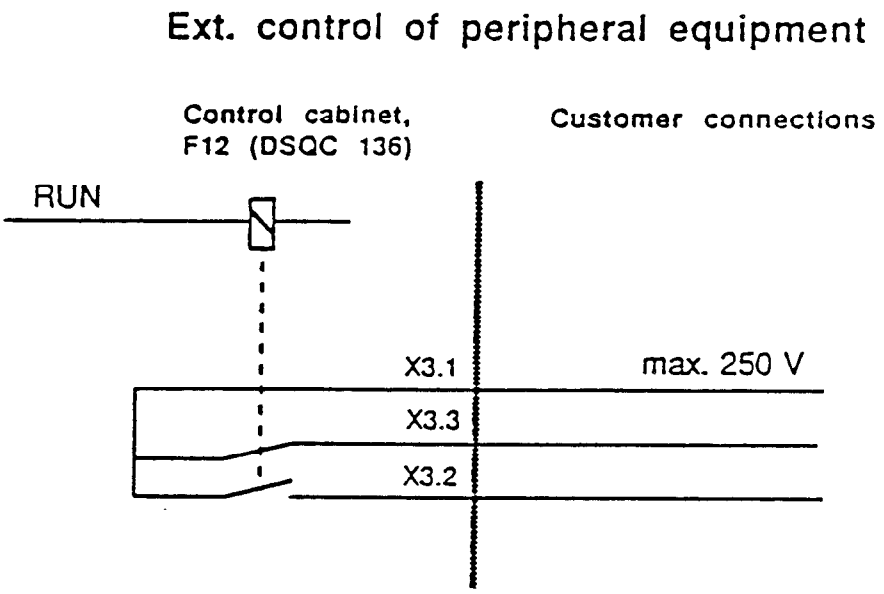
Connection table

Loop 1	F12.X4.3-4
Loop 2	F12.X4.1-2

The connections above are made directly at the plug that is fitted in the relevant connector on delivery. Remove the strap and connect the cable.

External operating loop

An external operating loop power by the customer can be controlled by a contact on board DSQC 136. This means that the robot system can switch equipment outside it on and off. See diagram below.



Technical data

Max. external supply voltage	150 V DC 125 V AC
Max. continuous current	2 A

Connection table

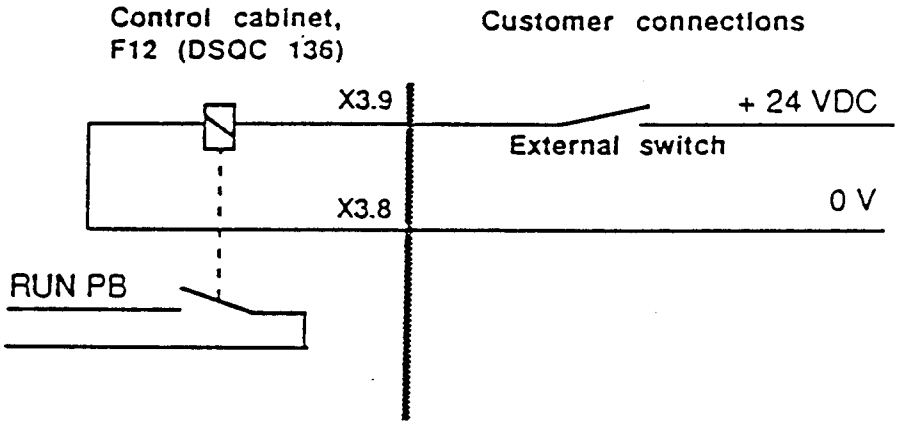
Break contact (NC)	F12.X3.1-3
Make contact (NO)	F12.X3.1-2

The connections above are made directly at the plug that is fitted in the relevant connector on delivery.

Remote control if RUN

With an external signal connected to unit DSQC 136, the robot system can be operated from STANDBY mode to RUN mode. See diagram below.

Remote controlled RUN



Technical data

External power supply	24 V d.c.
Current, relay coil	10 mA

Connection table

External contact	F12.X3.8-9

The connections above are made directly at the plug that is fitted in the relevant connector on delivery.

Test run with dead man's handle

When a connected programming unit is removed from its compartment (or on any other type of work hold), the robot can only be run if the safety plate on the programming unit is held down. The speed of the robot TCP is now normally reduced to 250 mm/s (or max. 25 % of max. speed). In systems equipped with unit DSQC 136, there is a keyswitch marked 100 % in the programming unit holder. If this switch is set to "On", the speed reduction is cancelled so that robot programs can be test run at full speed even though the programming units is removed from its compartment.

Reference: Programming manual

It is possible, by programming, to arrange a temporary connection between the robot system number register and external equipment. Such connections go via ports in the system. The following types of ports can be used:

- A group of digital inputs (4 or 8)
- A group of digital outputs (4 or 8)
- An analog output
- An analog input

Using the instructions in the program it is possible to:

- Decode an inport, binary or analog, and set the numerical value in a register.

- Code the numerical value in a register, binary or analog, and set an outport.

The following figures show which inputs and outputs are included in the different ports. Note that the digital inputs and outputs can also be used in the usual manner. See section 7.2.

Digital outputs

Port 1	1	First bit	(LSB)	4 bits (value 0 - 15)
	2			
	3			
	4	Last bit	(MSB)	
	5			
	6			
	7			
	8			
	9			
	10			
	11			
Port 2	12	First bit	(LSB)	4 bits (value 0 - 15)
	13			
	14			
	15	Last bit	(MSB)	
Port 3	16	First bit	(LSB)	8 bits (value 0 - 255)
	17			
	18			
	19			
	20			
	21			
	22			
	23	Last bit	(MSB)	
Port 4	24	First bit	(LSB)	8 bits (value 0 - 255)
	25			
	26			
	27			
	28			
	29			
	30			
	31	Last bit	(MSB)	

For connection to the different outputs, see section 7.2.

Digital inputs

	1	First bit	(LSB)	
	2			
Port 11	3			4 bits (value 0 - 15)
	4	Last bit	(MSB	
	5			
	6			
	7			
	8			
	9			
	10			
	11	First bit	(LSB)	
	12			
Port 12	13			4 bits (value 0 - 15)
	14	Last bit	(MSB)	
	15	First bit	(LSB)	
	16			
	17			
Port 13	18			8 bits (value 0 - 255)
	19			
	20			
	21			
	22	Last bit	(MSB)	
	23	First bit	(LSB)	
	24			
	25			
Port 14	26			8 bits (value 0 - 255)
	27			
	28			
	29			
	30	Last bit	(MSB)	

For connection to the different inputs, see section 7.2.

Analog outputs

Port 21	CH 1	(value 0 - ± 1000)
Port 22	CH 2	(value 0 - ± 1000)
Port 23	CH 3	(value 0 - ± 1000)
Port 24	CH 4	(value 0 - ± 1000)

Analog inputs

Port 31	CH 1	(value 0 - ± 1000)
Port 32	CH 2	(value 0 - ± 1000)
	'	(value 0 - ± 1000)
	'	
Port 62	CH 32	(value 0 - ± 1000)

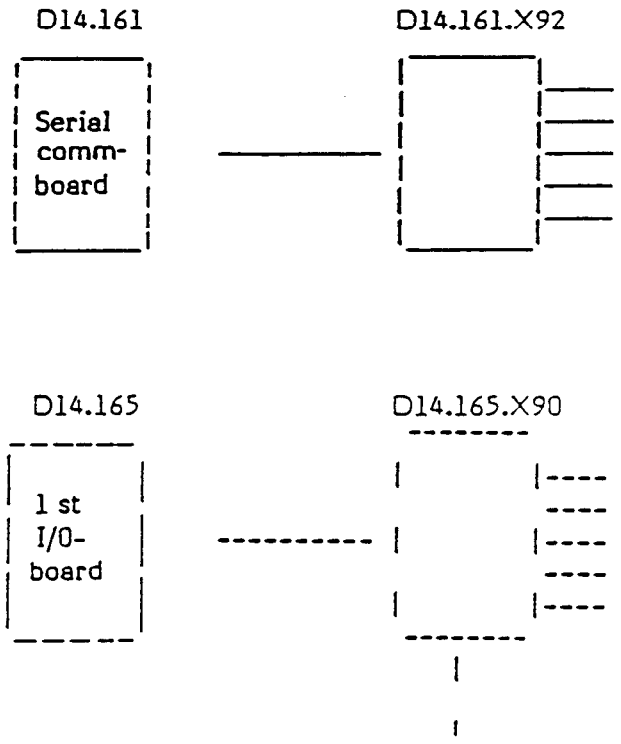
For connection to the different outputs, see section 7.3.

7.12
Serial communication unit (DSCA 114) for program printout

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

The control system can be provided with a serial communication unit for program printout. The unit consists of a connection unit located in the rear plane, H, of the control cubicle 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 before any input/output board as shown in the figure.



The serial communication board must be defined with the function parameters as described in Chapter 11.

8
CONNECTION OF SENSORS AND EXTERNAL AXIS

8.1
Grippers

A gripper can be connected to the turning disk on the wrist. The fixing dimensions are shown in Figure 8-1. To permit easy change of gripper, they are located with the outer circumference of the turn disk and a guide hole Ø 6 H8.

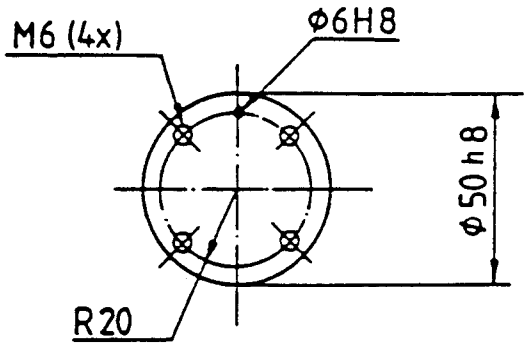


Figure 8-1

8.2
Sensors

Up to 16 sensors can be connected to the control equipment for adaptive control of the robot. (See the Operator's Manual.) For use of such sensors, the control system must also be provided with an adaptive control program. The sensors are to be defined with sensor data as described in section 11.3.1.

Connections, as described in section 7.5, are provided on the mechanical robot for the sensors.

The sensors can be of analog or digital type;

a) Analog sensors

The system must have available an appropriate analog input if an analog sensor is to be connected. The analog signals can be affected by interference and are to be protected as described in Chapter 5.

An analog sensor is to be connected to the analog input with the same number.

The number of the sensor is defined with sensor data. See section 11.3.1.

b) Digital sensors

Existing digital inputs are used for connection of digital sensors.

Digital sensors can be of three different types:

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

Sensors of the on/off type are connected to a digital input, three level sensors to two digital inputs and multi-level sensors can be connected to a maximum of 8 digital inputs corresponding to several level sensors with 8 bits, one bit constituting a sign bit. Thus each digital input represents one bit.

The number of bits for each sensor and at which input the last bit (MSB) is to be connected are specified with sensor data (see section 11.3.1).

The succeeding bits are connected to the preceding inputs as shown below:

```
        INPUT 1
        '
        '
        '
                                Sensor (n bits)
-------------------------------------------------------
        INPUT X          ------> Bit n (LSB)
        '
        '
        '
        INPUT X + N      ------> Bit 1 (MSB)
-------------------------------------------------------
        '
        '
        '
```

X = Input for connection of the last bit of the sensor (LSB). If n > 2 this constitutes the sign bit.

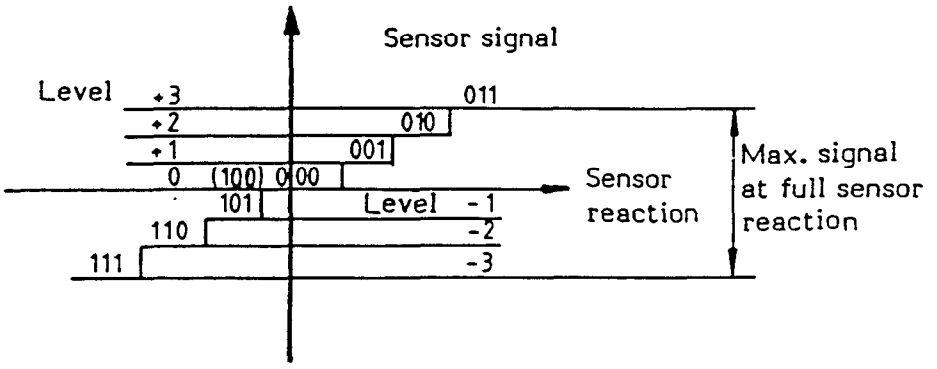
X + N = Input for connection of the first sensor bit (MSB).

N.B. Inputs X and X + N must both be included in the same group, see table below.

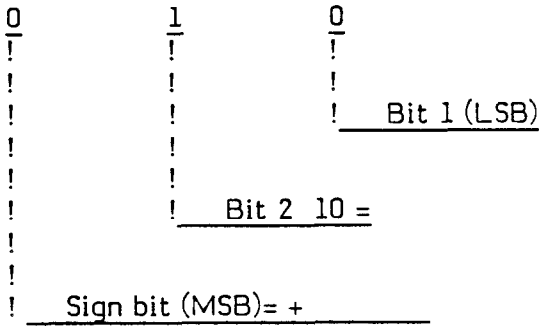
Group	Input nr	Number of bits
1	1 - 7	7
2	8 - 14	7
3	15 - 22	8
4	23 - 30	8
5	31 - 38	8
etc.	etc.	All following groups contain 8 bits.

Examples:

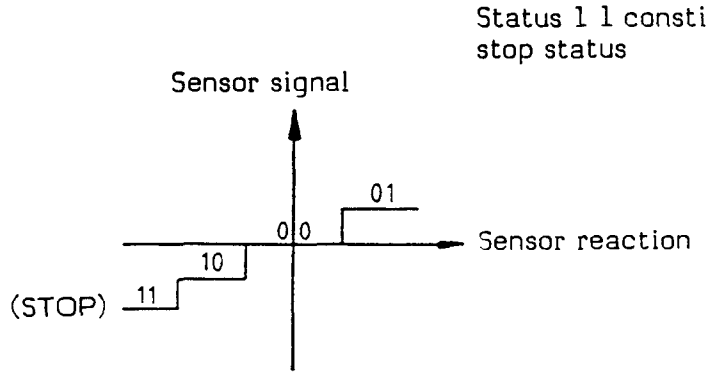
1. Sensor of multi-level type with 3 bits. The characteristic of the sensor then becomes:



Level + 2 is given by 010 where:



2. Sensors of 3 level with 2 bits. The characteristic becomes the following:



9
MAINS VOLTAGE CONNECTION

Mains voltage is normally connected to the terminal block F4.X1. This is located on the left hand side of the control cabinet. Protective earth is connected to the earth bar located on the floor of the cabinet, connections are made via the cable gland Ø 16 mm in cover plate F1. If the control cabinet is supplied with a safety switch, then mains connection is made directly to this.

See Chapter 5 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: 6.3 kVA (complete system)

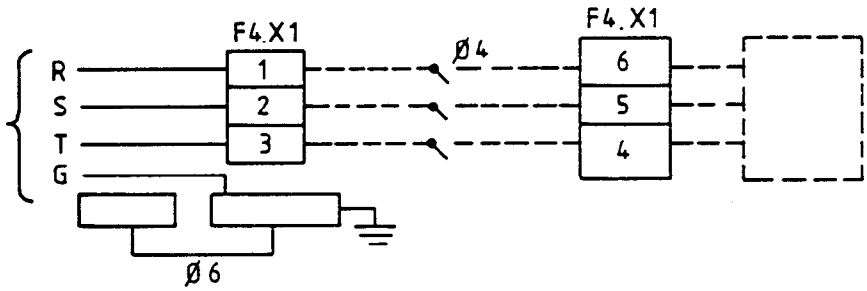


Figure 9:1

N.B. Connection in correct phase sequence is essential!

Protective earths are to be connected to the central earth. The control cabinet must be earthed for interference protection purposes with a heavy copper conductor, at least 10 mm^2 connected to the earthing bar of the cabinet as shown in Figure 9:1.

To develop the maximum possible resistance to interference effects in the total installation, all of its units should be connected to a common earth.

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 a transformer switchable for four different voltages; 380, 415, 440 or 475 V. See table 9-1.

Table 9-1

380 V	+12%
	-15%
415 V	+10%
440 V	-15%
475 V	

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

10
APPLICATION VOLTAGE AND START-UP

Reference: Programming Manual

Moment 1 Before switching on voltage, check that:

- Strap S1 and S2 on the rectifier D28.1.4 is set correctly.

No strapping	50 Hz
S1:1-2 and S2:1-2	60 Hz

- The mains voltage available is correct (by measurement) and that the phase sequence is correctly connected, see chapter 9.
- The fuse on the primary side is installed correctly, see chapter 9.
- The necessary safety measures according to chapter 2 have been taken.

Moment 2 The programming unit must be connected before switching the mains switch on.

1 Check that the lamp STANDBY is lit, and that the cooling fans are rotating. If the ERROR lamp is illuminated, continue with point 2. Otherwise, continue directly with point 3.

2 If the system has been inactive more than 1500 hours, the function parameters might have been lost from the memory. After the language selection, "PARAMETER MEMORY FAULT, RELOAD!" is presented on the programming unit display. See chapter 11, Function Parameters for detailed information regarding this status.

3 If it is necessary to change language, continue with point 3.1. Otherwise, continue directly with point 4.

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

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

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

If such text is presented, continue with point 3.4. Otherwise repeat the points 3.2 and 3.3 until the text with an asterisk appears.

3.4 Press the button directly under the text with the asterisk.

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

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

5 Synchronize the robot by pressing SYNCH. The automatic synchronization of the robot then begins and the SYNCH 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 re-synchronizing an already synchronized robot, press SYNCH twice. (The first time the SYNCH lamp starts flashing only, while the synchronization movement starts after pressing the second time.)

When the synchronization is completed, the SYNCH lamp extinguishes.

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

11
FUNCTION PARAMETERS AND SENSOR DATA

11.1
General

Reference document: 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 (approx. 1500 hours). If the system has reserve voltage for memory back-up (see section 7.4.4), 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 11.3)

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 Chapter 11.2). This is always recommended if the contents vary from normal values. The programmer can then restart the system quickly after any extended supply failure.

Note: 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, this means that the robot must be synchronized and that all outputs and registers are cleared.

11.2
Entry of function parameters

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 that are entered but are to be changed, complemented or stored on a floppy disk.

Type case A:

1. Start the system as described in Chapter 10.

2. Read, in status STANDBY, the text display on the programming unit. If the text PARAMETER MEDMORY FAULT, RELOAD 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 thelower 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 10 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:

1 Press STANDBY. If the robot system is prepared for computer link, proceed to point 1.1, otherwise see point 2.

   1.1 Press MANUAL button (the button with a hand engraved) on the programming unit.

   1.2 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.

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

   1.4 Press the button below LOCAL.

2 Seek status PARAM by activating:

   a) Control button MAN.
   b) Function button SCAN
   c) Function button PARAM

3 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 deviates 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.

11.2.1
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 an 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. Depress the button immediately under the text required.

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

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. Depress the button below 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:

The function parameters which can be defined and the range of permissible values are given in the table 11-1.

After changing the parameter "WORK AREA EXTERNAL AXIS" a value must always be entered. Otherwise the system will stall and show errorcode "3 DATA ERROR". To restart the system again the main computer must be initiated.

After changing the parameters press ACTIVE to leave the parameter menu.

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 11.2, Type case A.

The function parameter memory can be erased if the voltage to the system is switched off while parameters are being entered and at least one parameter has been changed.

Table 11-1 Modification of function parameters

MENU	Function parameters	Alternative	Normal value	Notes
IN-OUT	I/O TYPE Type and location of extra input/output board	I/O 165 = y I/O 169 = y I/O 173 = y I/O 177 = y	Not equipped = 0	The value "y" specifies the type of board 3) 1 = DSDX 110 10 = DSAI 120 11 = DSAO 110
	COMM BOARD Serial communication board for computer link and program printout	Yes = 1 No = 0	No board = 0	
	BAUD RATE Transmission speed on channel 0 with program printout	CH = 0 CH = 1	CH = 0	Relevant only when response = 1 is given to the preceding question. 0 = 300 baud 1 = 1200 baud
	MONITOR	No = 0 Yes = 1	No = 0	
AXIS	WORK AREA ROBOT AXES Working area for the 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	A1- = -180° A1+ = +180° A2- = -40° A2+ = +40° A3- = -25° A3+ = +40° A4- = -90° A4+ = +90° A5- = -180° A5+ = +180°	* The working range must include the synchronization position.

Table 11-1 Modification of function parameters

MENU	Function parameters	Alternative	Normal value	Notes
	WORK AREA EXTERNAL AXIS Working area for external axis	A6- = y A6+ = y A7- = y A7+ = y A8- = y A8+ = y A9- = y A9+ = y	No external axis = -2147483648	The value "y" specifies the number of increments 1) 1 increment = $\frac{1}{640}$ resolver rev. Definition range $-2^{31} \leq y < 2^{31}$ Resolution 1
	KV Entry of position gain amplification K_V for external axes 4)	A6 = y A7 = y A8 = y A9 = y	Deactivated regulator (-1)	Definition range $K_V = 0.5 \times (2 \leq y \leq 100)$ 1/S Resulution 1
AXIS	AXIS BRAKE Holding brake on axes	A1 = 0 or 1 A2 = A3 = A4 = A5 = A6 = A7 = A8 = A9 =	A1 - A5 = 1 A6 - A9 = 0	A1 to A9 gives axis 1 - 9 2) 0 = without holding brake 1 = with holding brake
ACTIVE	ACTIVE Exit from the parameter menu and activation of the function parameters which have been changed. Parameters which have not been changed keep their earlier value.			

Table 11-1 Modification of function parameters

MENU	Function parameters	Alternative	Normal value	Notes
PROM	PROM Selection of the function parameters stored in the PROM.			
KEY	KEY Blocking of the programming unit functions with the key on the control panel	KEY = 0 KEY = 1	KEY = 0	0 = Programming not possible. 1 = The complete programming unit is blocked. See fig. 11-2
SYNC	SYNC POS NO Selection of synchronizing position for the first axis (C-axis)	SYNC POS NO = 0 = 1 4) = 2 4)	SYNC POS NO = 0	
MEMORY	MEMORY	0 = 8 kword 1 = 32 kword	0 = 8 kword	The value 1 requires an extra memory board.
SOFT S	SOFT SERVO Soft position control of one or more robot axes	No = 0	No = 0	
INCH/MM	INCH/MM Selection of European or American units for programming unit communication	= 0 = 1	= 0	0 = European units (mm and mm/sec and kg) 1 = American units (inch and inch/minute and pound)
0-ZONE	0-ZONE	SMALL LARGE XLARGE COARSE	SMALL = 1 LARGE = 8 XLARGE = 50 COARSE = Not def.	Selectable between 1 and 300.

Table 11-1 Modification of function parameters

MENU	Function parameters	Alternative	Normal value	Notes
TIME	TIME Time limit on the instruction conditional WAIT with the optional time supervision	TIME = y	60 s	The value "y" indicates the max. waiting time in seconds. Definition range $0 \leq y \leq 320$ s. Resolution 1 s.
C LINK	IRB IDENTITY Selection of robot identity in relation to superior computer with computer link	IDENTITY = y	IDENTITY not given = 0	The value "y" can be 0 - 127
S ADAPT	SERVO ADAPTIVITY	1 = Yes 0 = No	0 = No	Requires servo control board YYT 102 G (version 2 or later) and DSQC 117.
	CONFIGURATION	= 0 = 1 = 2 = 3	= 0	**Only if YES in previous question!** 0 = Without WAC 1 = With WAC 2 = Not used 3 = Not used
GRIPPER	GRIPPER Selection of the number of grippers	2 - 8	2	The parameter is only valid for IRB 90 Material handling robot. Certain outputs will be reserved for the grippers depending on the number of grippers selected.

Table 11-1 Modification of function parameters

MENU	Function parameters	Alternative	Normal value	Notes
OPTION	AMS Type of system	0 = Servo system with sync. switches 1 = Absolute measuring servo system	0 = Servo system with sync. switches	The parameter value must correspond to the servo system of the robot.
	RESTART Restart enable or disable	0 = Restart disabled 1 = Restart enabled	0 = Restart disabled	Valid only when parameter AMS = 1
	VISION	0 = Robot system not equipped with Vision functions 1 = Robot system equipped with Vision functions	0 = Without Vision functions	The parameter is only valid for IRB 90 Material handling robot. The value 1 requires a robot system with Vision equipment.
	HOLD RC Hold-to-run control	0 = Hold-to-run control disabled 1 = Hold-to-run control enabled	0 = Hold-to-run control disabled	

PARAMETERS FOR ARCWELDING

Function parameters	Alternatives	Normal value	Notes
VOLTAGE PORT Port number for voltage reference signal	21 - 26	25	Menu: VOLT + PORT
1. PARAM MIN (V) Minimum welding voltage	Def. range: 0-100 V Resolution: 0.1 V	0	Menu: VOLT + VALUE
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 V Resolution: 0.1 V	0	
4. REF MAX (V) Maximum value for voltage reference	Def. range: -10 - +10 V Resolution: 0.1 V	0	
CURRENT PORT Port number for current reference signal	21 - 26	26	Menu: CURR + PORT
1. PARAM MIN (A) Minimum welding current	Def. range: 0-1000 A Resolution: 0.1 A	0	Menu: CURR + VÄRDE
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 A Resolution: 0.1 A	0	
4. REF MAX (A) Maximum value for current reference	Def. range: -10 - +10 A Resolution: 0.1 A	0	
1. TYPE OF MOTION Linear or rotating external axis	ROT = 0 LIN = 1		Menu: AXIS + EXTAX
2. GEAR RATIO LOW Gear ratio for motor axis	Def. range: 0 - 65535 Resolution: 1 Value 0 means gear ratio not defined.		
3. GEAR RATIO HIGH Gear ratio for outgoing axis	Def. range: 0 - 65535 Resolution: 1		
COMMON DRIVE UNIT Common drive unit for two external axes (6-8 resp. 7-9)	1 = Present 0 = Not present	Not present (0)	Menu: AXIS + COMMON

1) Value omitted means that the axis is not defined: The working range is defined for positive or negative direction from the synchronizing position.

2) The axes of the robot are numbered as shown in Figure 11:1. IRB L6E is provided with brakes on all axes. If it is not known which axes are provided with brakes, a check can be made by switching to STAND BY and attempting to move the different axes manually.

   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 Chapter 7.2.3. DSQC 114 can only be activated on places IO 173 and IO 177.

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

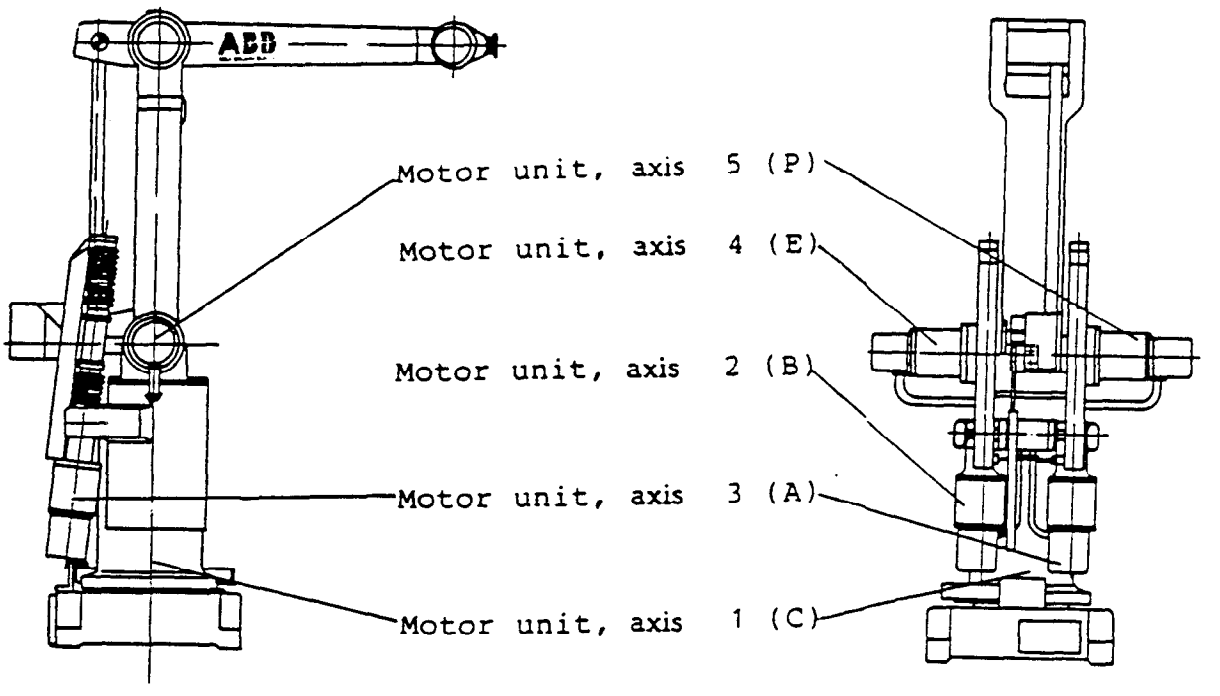


Figure 11:1 Axis numbers

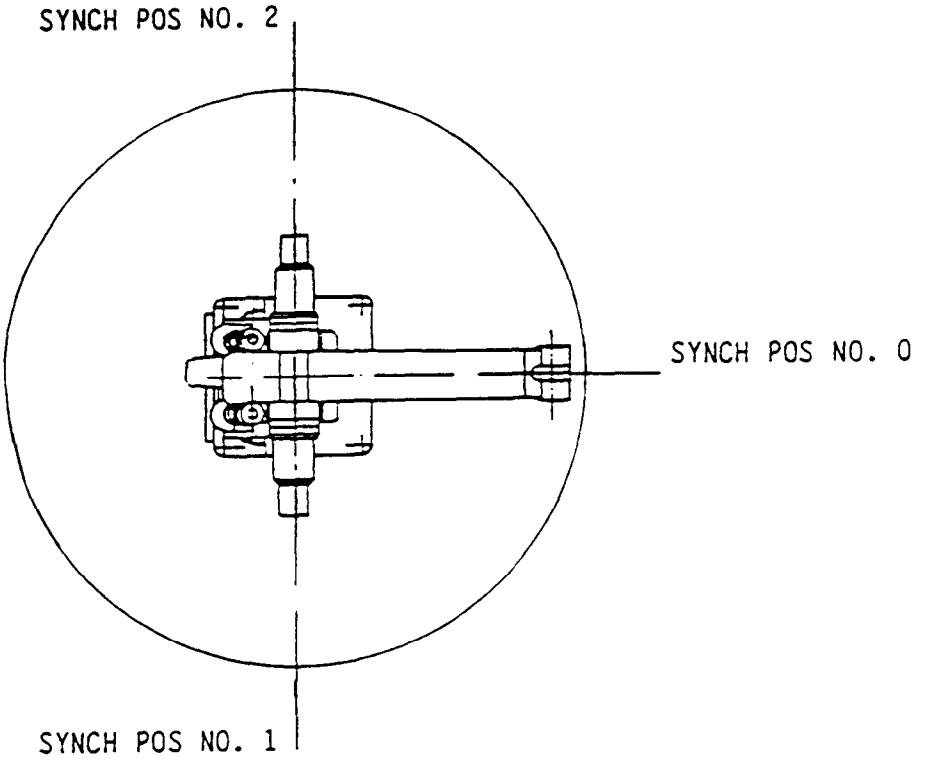


Figure 11:2 Synch position of the C-axis

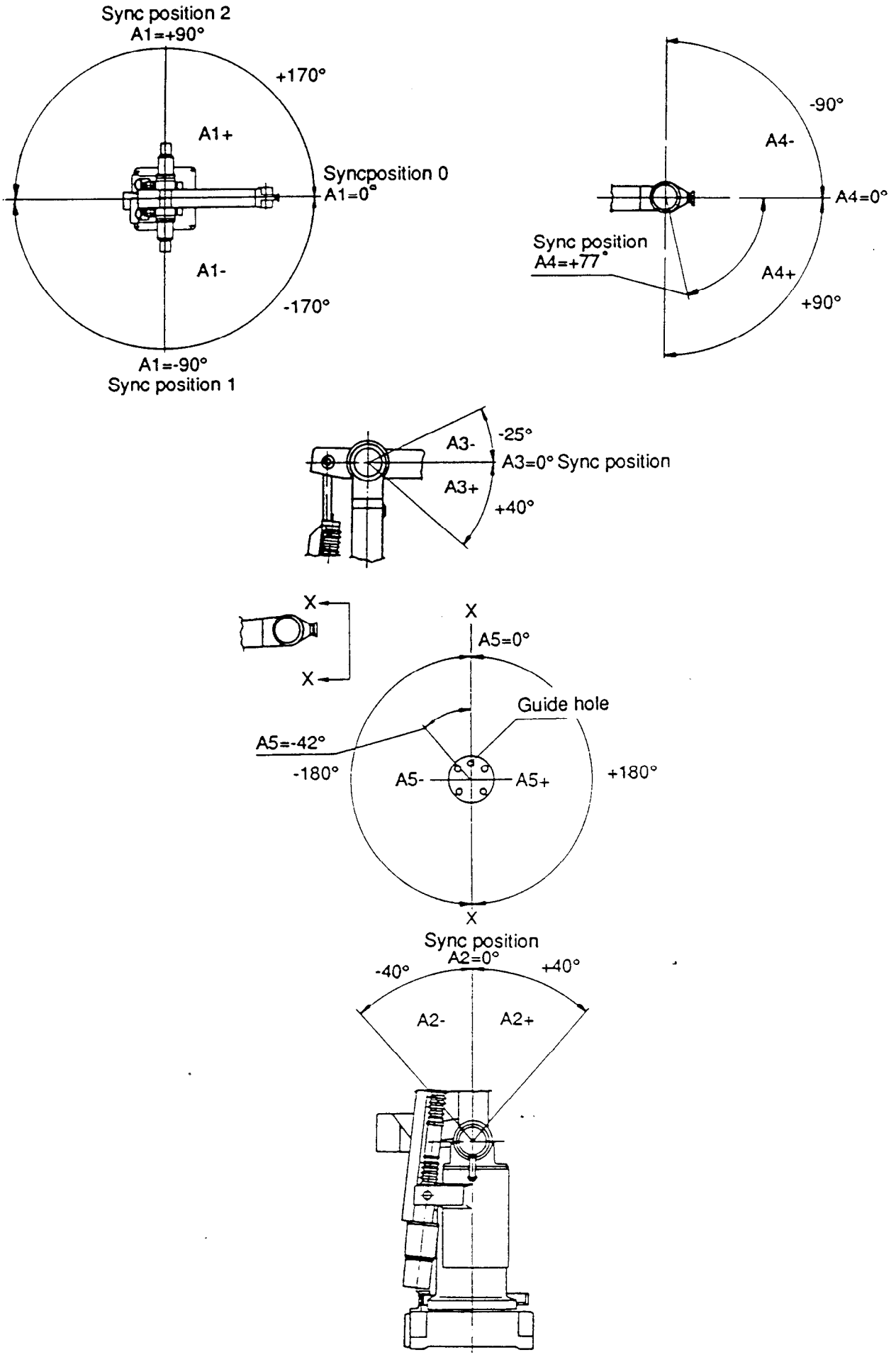


Figure 11:3 Sync. positions and working range

11.3
TCP and sensor data

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

For definition of TCP, see Programming Manual.

11.3.1
Entry of sensor data

For connection of sensors, see section 7.2.

Obtain the status SENSOR by activating:

1. a. 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 NO = CE ENTER

3. Enter sensor number 1 to 16 (7) and issue the command ENTER.

   S7

   NUMBER OF BITS = CE ENTER

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

   S7 R 8B INP 77 1.0 -100/100

   NUMBER OF BITS = CE ENTER

   There are two alternatives: PREVIOUSLY DEFINED
   and UNDEFINED SENSOR

   A) If the sensor is not defined, proceed to p. 4.
   B) If the sensor is defined, see p. 10.

4. Alternative A, undefined sensor.

   Type in the number of bits 0 to 8 (6) and issue the command ENTER.

   S7 6B

   INPUT NR = CE ENTER

   0 bits means that the sensor is analog.
   1-8 bits means that the sensor is digital.

   For digital sensors with three or more bits, the MSB is the sign bit.

5. Type in the input number for the MSB (62) and command ENTER.

   S7 6B INP 62
   INSTALLED ON ROBOT? YES NO

6. State if the sensor is installed on the robot or not (depending on the position of the robot hand).

   S7 R 6B INP 62
   SCALE: CE ENTER

7. Type in the gain value 0 to 99.99 (1.0) (sensor reaction mm/binary value) and 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 INP 62 1.0
   MORE SENSORS? YES NO

   The answer YES gives restart from 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 displayed:

   S7 R 6B INP 62 1.0
   MIN VALUE = CE ENTER

8. Type in the minimum permissible digital value from the sensor and command ENTER.

   S7 R 6B INP 62 1.0 -10/
   MAX VALUE = CE ENTER

   The max. value can be within the interval $\pm 2^{n-1}$ where n specifies the number of bits transmitted by the sensor.

   For an analog sensor, a sensor signal of +1 - 10 V corresponds to $\pm$ 1 + 0 Bits, i.e. n = 11. See Analog inputs, section 6.3.

9. Type in the maximum permitted digital value from the sensor and command ENTER.

   S7 R 6B INP 62 1.0 -10/15
   MORE SENSORS? YES NO

   The replies give restart from point 3 or point 1 respectively.

10. Alternative B, sensor previously defined

    The same sequence is run through. If ENTER is commanded with no data typed in, this will be interpreted as the acceptance of values previously entered. If the number of bits is changed, the maximum and minimum limits are cancelled.

12
RUNNING THE ROBOT

Reference document: Programming Manual

12.1
Check on working manual

- Press 'RUN' button and verify the 'STANDBY' lamp has extinguished. Verify that the 'RUN' button lamp is illuminated. Check that there has been no movement in any of the robots axis.

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

- Run the robot manually by using the joystick and check that the motion in both directions in x-y and z-axis are possible. Also check that the extreme position can be reached.

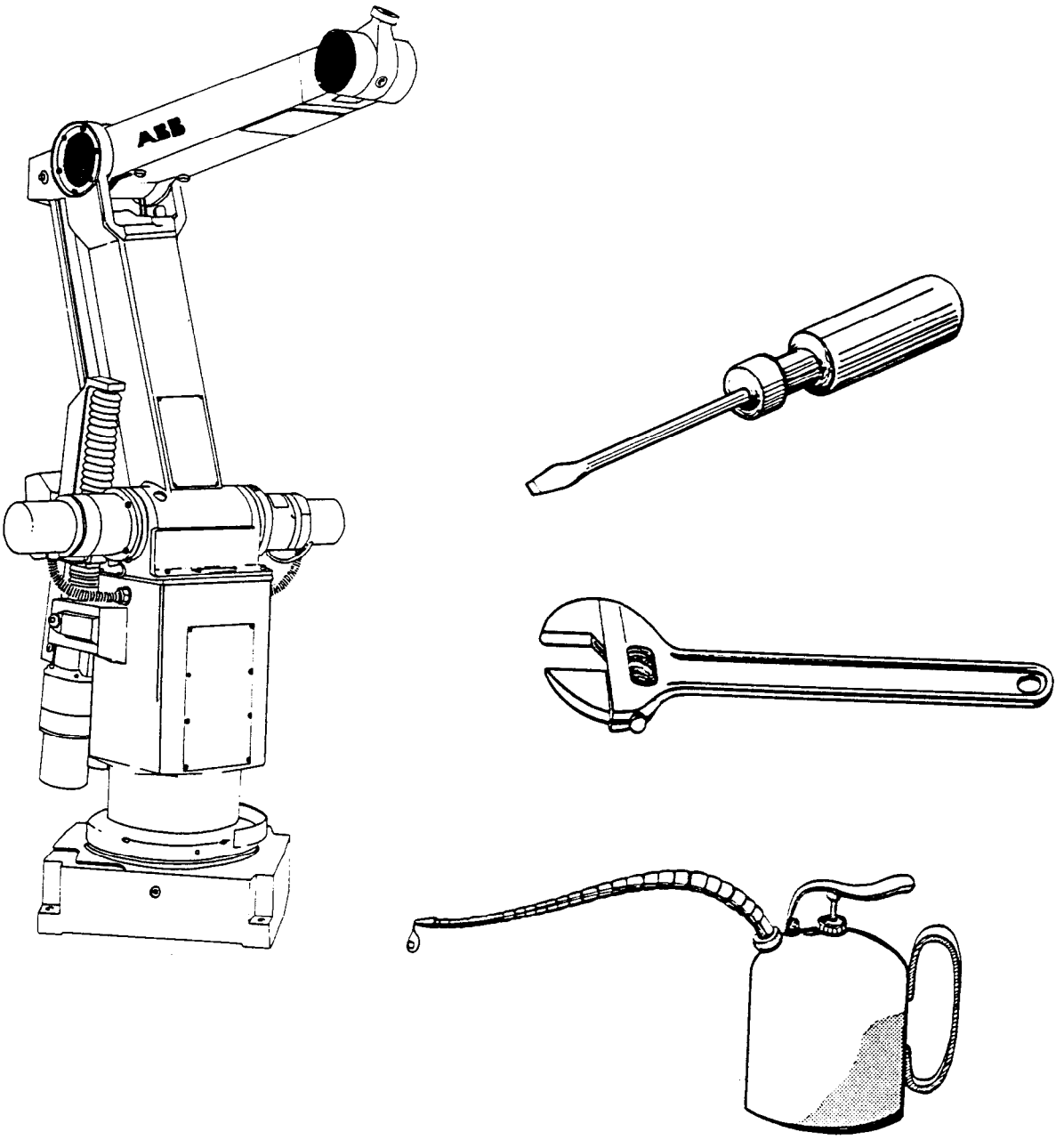
12.2
Check on the operation functions

- Program a simple movement pattern with a number of fine and coarse points. Check that the program is executing correctly by stepping, using the function button 'INSTR ST' and with 'VELOCITY' approximately 200 mm/s.

- Press the 'AUTO' button and verify that lamp 'AUTO' is illuminated, check that the program is executing correctly in the operation mode 'AUTO'.

- If the control equipment has been provided with a floppy disk unit, this may also be checked by reading the program onto a floppy disk, then loading it back to the memory. Check that the program is correct by running the robot in operational mode 'AUTO'.

Maintenance
IRB L6E



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October 1989

ABB
ASEA BROWN BOVERI

Article number: 6397 016-302
Issued:October 1989

ABB Robotics AB
S-721 68 Västerås
Sweden

MAINTENANCE

1 GENERAL

To ensure reliable, and consequently economic operation of the robot system, it must be properly maintained and serviced. It is therefore important that the oil is changed in the gear boxes, the ball screws are lubricated, and routine checking of the control cabinet is performed (including vacuum-cleaning) at the recommended intervals.

Tools required

- Vacuum-cleaner
- Brush
- Normal hand tools
- Syringe 20 ml (art. no. 6883 053-B)

Safety precautions

During maintenance - all persons who have reason to be within the working are of the robot should be familiar with robot performance and any hazards connected therewith.

When working on the robot, personnel must be familiar with the electrical system and must be able to disconnect the robot. They must also know where the emergency stop switches are located so that power can be cut off immediately if there is any danger.

When working on the control system:

- Remember that certain parts of the system are connected to the mains (line transformer, power supply and stabilizer unit, for instance).

- Make sure that nobody is within the working range of the robot as long as the control system is in operation mode, i.e. when the robot motors are running.

- When replacing electrical sub-units such as circuit boards or reconnecting any of the electrical connections, the main circuit breaker on the operator's panel of the control cabinet must be turned off. Otherwise the unit may be damaged.

Changing oil in the gear boxes

Upon delivery, the gear boxes are filled with oil to the correct level. The oil must be changed after six months or a minimum of 1000 hours in operation.

Note that you have to ventilate the gear boxes in order to refill any oil. This is done by lifting the oil injector now and then during the filling.

Syringe (6883 053-B) should be used for filling oil.

Oil type:	ATF, typ A, suffix A
Producer's designation:	Shell Donax T6 Mobilfluid ATF 200 Esso ATF

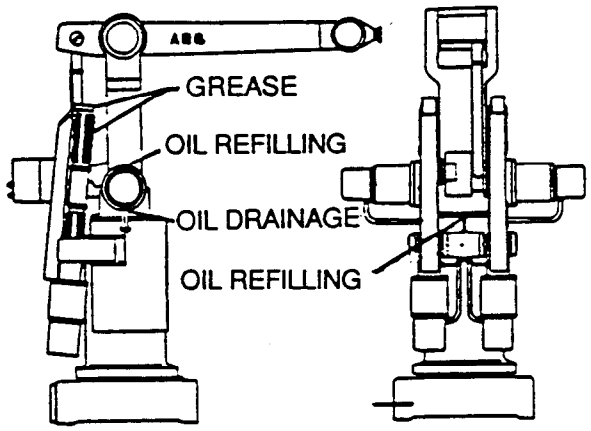


Figure 1A

Oil quantity IRB L6E:

Floor-mounted robot:

Axis 1 (C)	80 cm^3
Axis 4 (E)	35 cm^3
Axis 5 (P)	35 cm^3

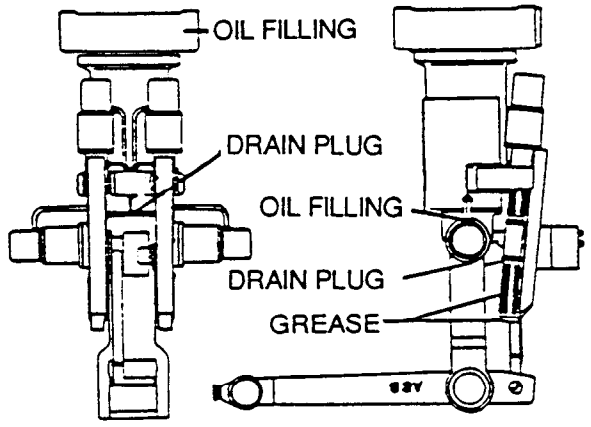


Figure 1B

Suspended robot:

Axis 1 (C)	260 cm^3 1)
Axis 1 (C)	330 cm^3 2)
Axis 4 (E)	35 cm^3
Axis 5 (P)	35 cm^3

1) If the drain plug is located on one side of the gearbox.

2) If the drain plug is located on the intermediate plate.

Lubrication of ball screws

The ball screws shall be lubricated every three months or after 300 hours in operation.

Recommended lubricant: ESSO BEACON 2 or similar grade.

- The protective bellows over the ball screws must be released to enable lubrication of the ball screws. It might be sufficient to cut only the lower cable tie (Fig. 2A, item 1) of the upper bellow and the upper cable tie (Fig. 2B, item 1) of the lower bellow.

- Move the ball nut to its lowest position. Press up the upper bellow away from the ball nut. Wipe off old grease with paper or a lint-free cloth. Do not polish and do not use degreasing chemicals!

  Move the ball nut to its uppermost position. Press the lower bellow downwards away from the ball nut and wipe off old grease from the lower part of the ball screw.

- With the ball nut still at its uppermost position, apply new grease with a brush directly on the threads of the ball screw. Move the ball nut up and down a number of times and if necessary, apply some more grease.

  CAUTION! Do not apply too much grease because then the mechanical resistance will be too high and might cause emergency stops later when the robot runs.

  Repeat for the upper part of the ball screw and apply some grease on the upper ball bearing.

- When replacing the bellows, fit new cable ties.

- If any of the bellows are worn, they should be replaced by new ones in order to avoid dust or dirt entering the ball nut. For information on replacing the bellows, see the Service Manual.

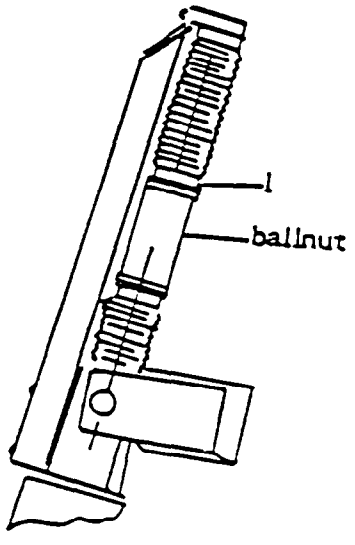


Figure 2A

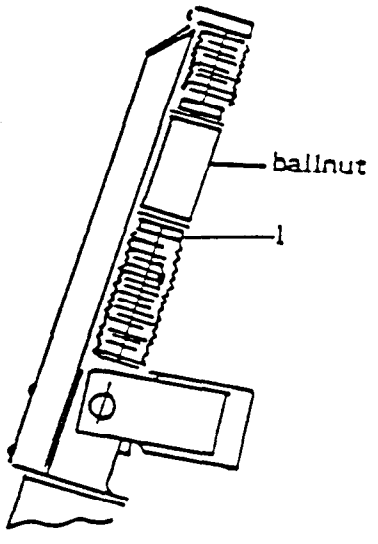


Figure 2B

3
MAINTENANCE OF ELECTRONICS

The control system is composed of various electronic units. The electronic components require only visual inspection and occasional vacuum-cleaning.

Routine inspection of control cabinet

The control cabinet is completely enclosed and the electronics thus protected from normal factory surroundings. However, in surroundings with much dust the cabinet should be inspected regularly inside. Any deposits should then be removed by brushing or vacuum-cleaning, for instance. The power should be disconnected.

- o Check that the fans are working both in the control cabinet and in the floppy disk enclosure.
- o Check that the sealing strip and cable grommets in the cabinet seal properly, so that dirt is not sucked into the control system.
- o Check that the cabling to the programming unit is not visibly damaged in any way.

Replacing the batteries for the memory back-up

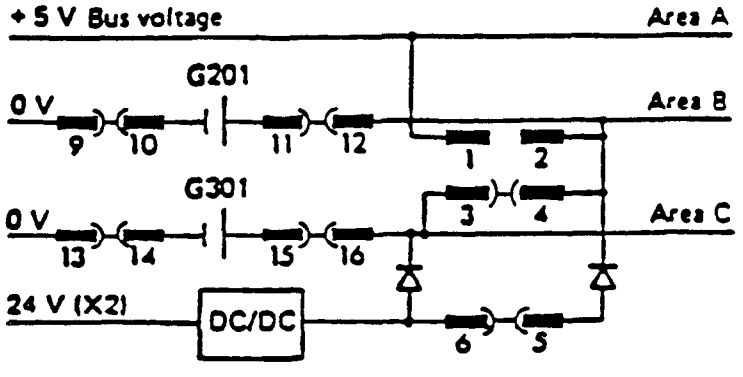
The two memory back-up batteries, which are soldered directly to the memory board have a minimum life expectancy of 4 years, and should therefore be changed every 4:th year to ensure secure operation.

N.B. It is advisable to store the memory contents into a floppy disk, before removing the memory boards, and then reload the memory after the batteries are replaced.

To avoid that the memory contents are destroyed, when the batteries are de-soldered from the boards, you are to exchange one battery at a time as follows:

1. Remove the jumpers S2:9-10 and S2:11-12
2. Exchange the battery G201
3. Reinstate the jumpers S2:9-10 and S2:11-12
4. Remove the jumpers S2:13-14 and S2:15-16
5. Exchange the battery G301
6. Reinstate the jumpers S2:13-14 and S2:15-16

See circuit diagram below.



Circuit diagram, batteries for memory back-up

Indicator lamps

- Check that all lamps on the control panel are working by pressing the lamp test button.

- Defective lamps can be replaced by turning the plastic lens anti-clockwise and then removing the bayonet-fitting lamp by pressing a piece of plastic or rubber tubing over the bulb and turning 1/4 turn anti-clockwise. Replace in reverse order.

Floppy disk unit

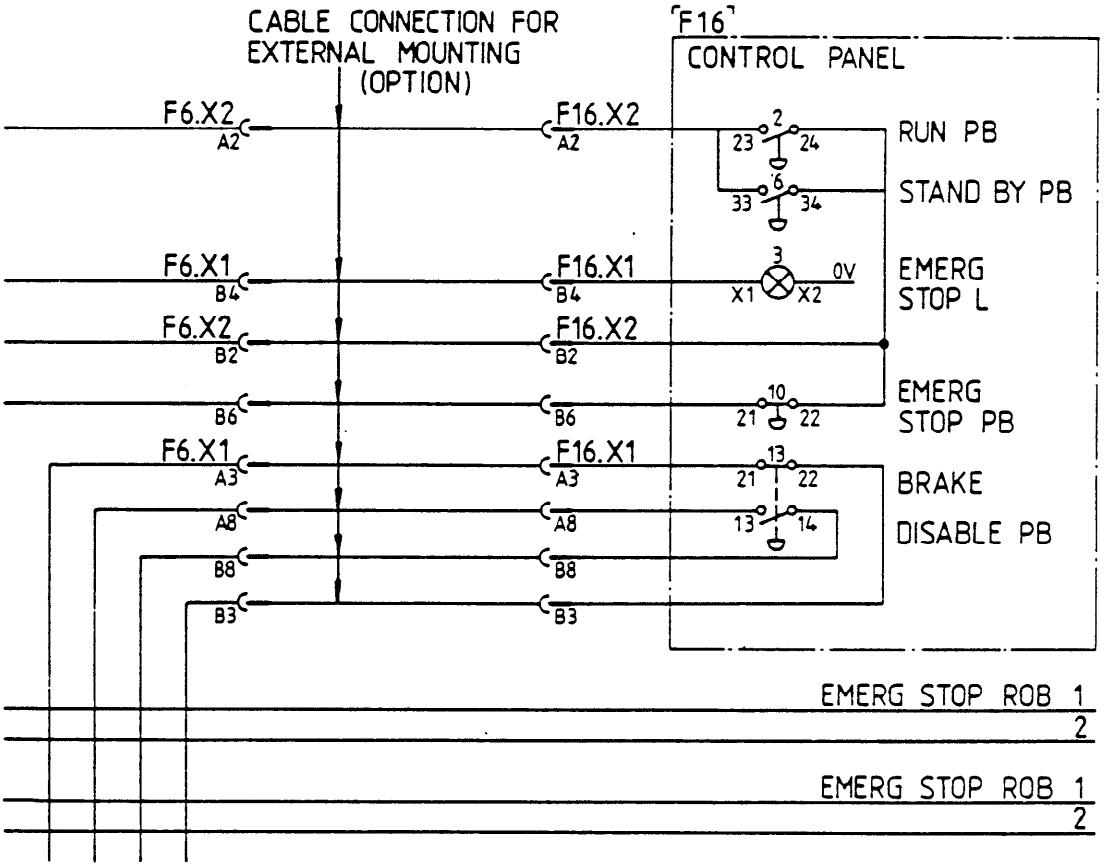
- The protective cover plate shall always been shut.

- Floppy disks should always be stored in an office environment and at normal room temperature. Temperatures exceeding +50 °C can permanently damage the information stored on a disk. In areas where magnetic interference is likely, the disks should be restored in a steel box.

- The floppy disk unit can be tested by first recording a program and then reading it back to the control system again. The built-in function tests will then check if the unit is functioning correctly. As long as no error lights or error messages are apparent, the unit is satisfactory.

- If difficulty in reading or writing is experienced, the read and write head can be cleaned by using a special cleaning disk in conjunction with the Test adapter program for the disk unit (see the Service Manual).

Circuit Diagrams
IRB L6E



6397 015-128
October 1989

ASEA BROWN BOVERI

SHEET BLAD	CONTENT INNEHÅLL
1	LIST OF CONTENTS INNEHÅLLSFÖRTECKNING
2	CONNECTION POINT LOCATIONS IRB L6E ÖVERSIKT ÖVER DELNINGSPUNKTER IRB L6E
3	AXIS 1 AXEL 1
4	AXIS 2-3 AXEL 2-3
5	AXIS 4-5 AXEL 4-5
6	CUSTOMER CONNECTIONS KUNDANSLUTNINGAR
7	SYNC. SWITCHES, LIMIT SWITCH SYNK. BRYTARE, GRÄNSLÄGESBRYTARE

AUTO CAD

PRIMARY PART IN ARCADE

Rev Ind	Revision	Appd	Year	Week
1	IRB G6 deleted		89	45

LIST OF CONTENTS
INNEHÅLLSFÖRTECKNING

Design checked by: GEPERTZ
Drawing checked by: PERSSON
Drawn by: STRID

CIRCUIT DIAGRAM
IRB L6E

Iss by Dept Year Week: BPM 89 25

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Rev Ind	Cont: 2

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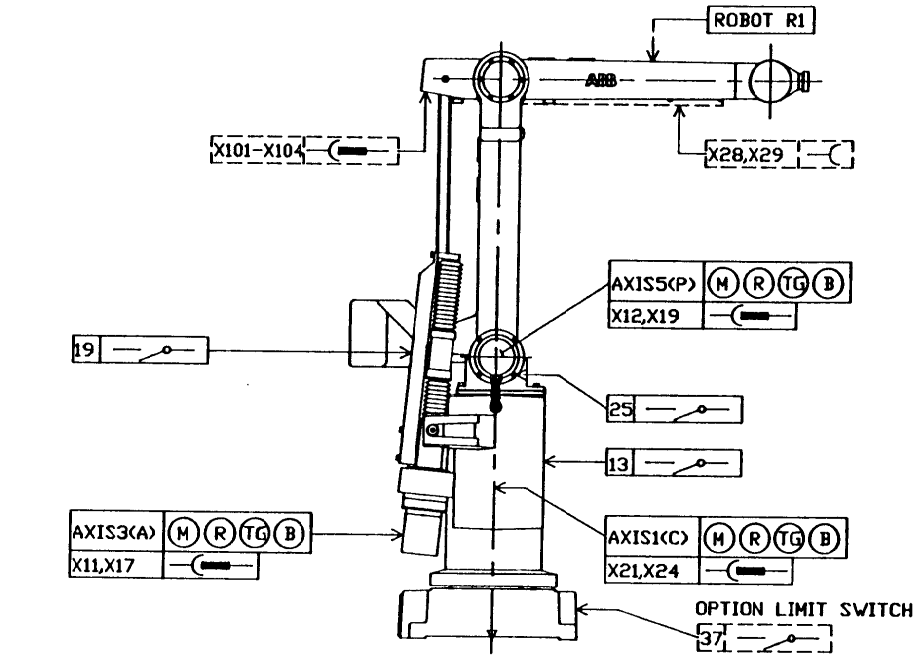

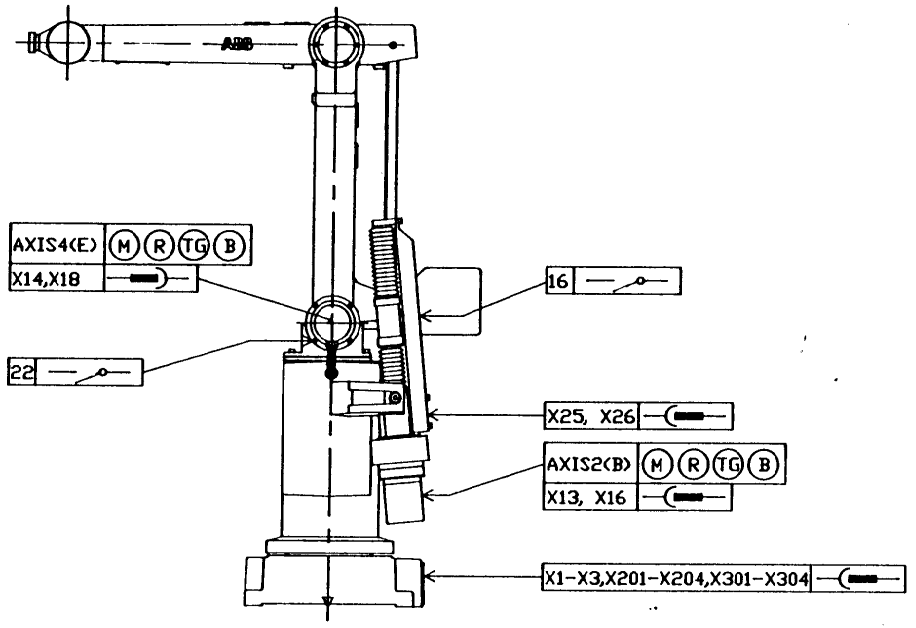

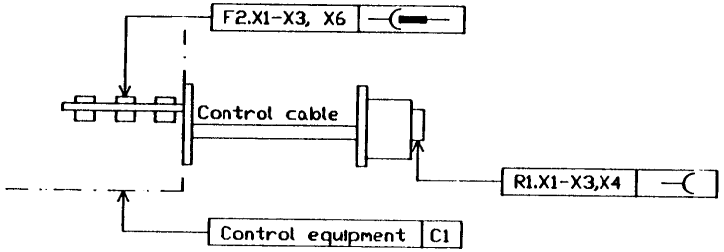

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Rev Ind	Revision	Appd	Year	Week
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CONN POINT LOC IRB L6E
ÖVERSIKT DELNP IRB L6E

Design checked by: GEPERTZ
Drawing checked by: PERSSON
Drawn by: STRID

CIRCUIT DIAGRAM
IRB L6E

Iss by Dept' Year Week: BPM 89 25

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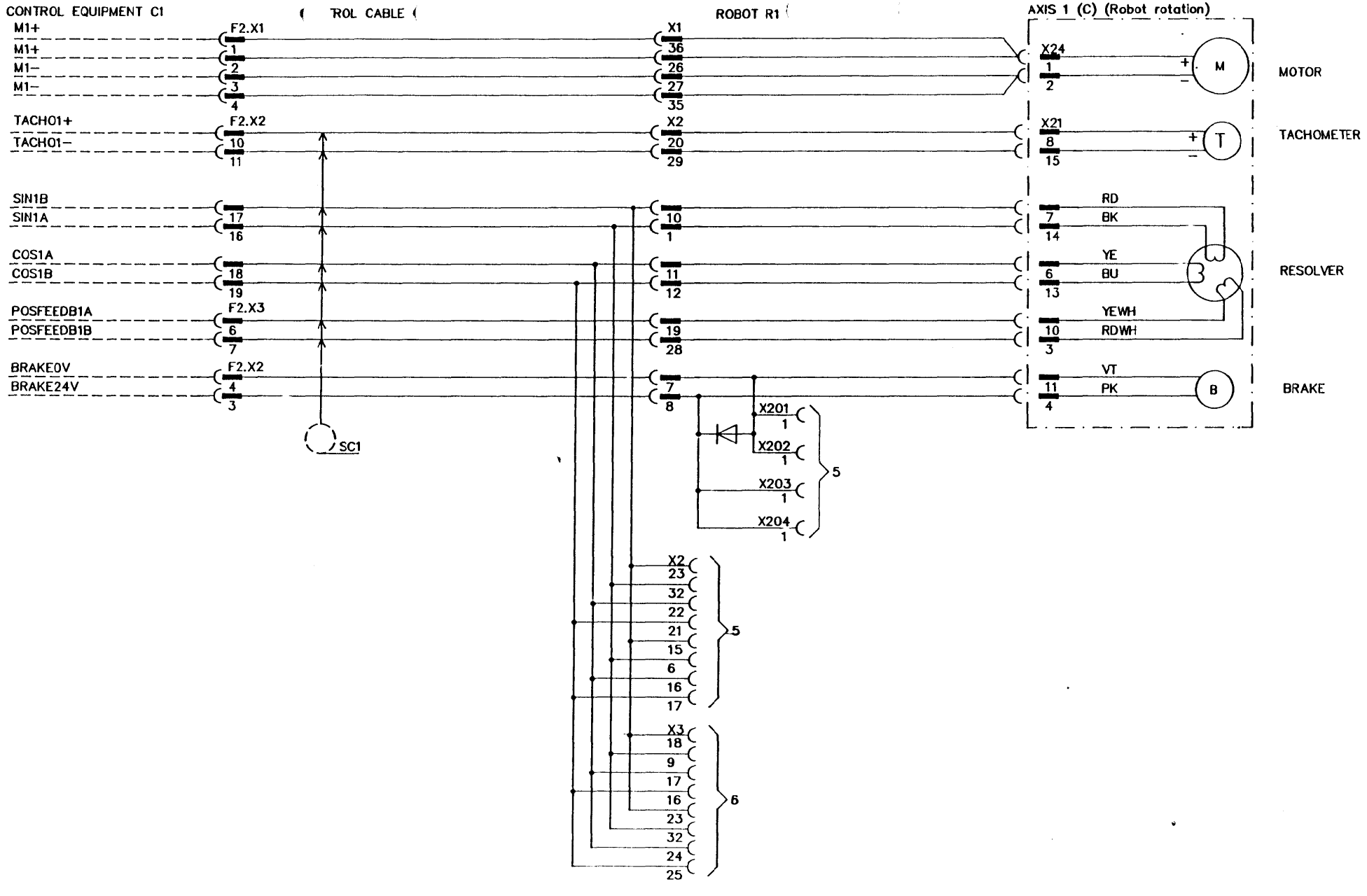

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Rev Ind	Revision	Appd	Year Week				

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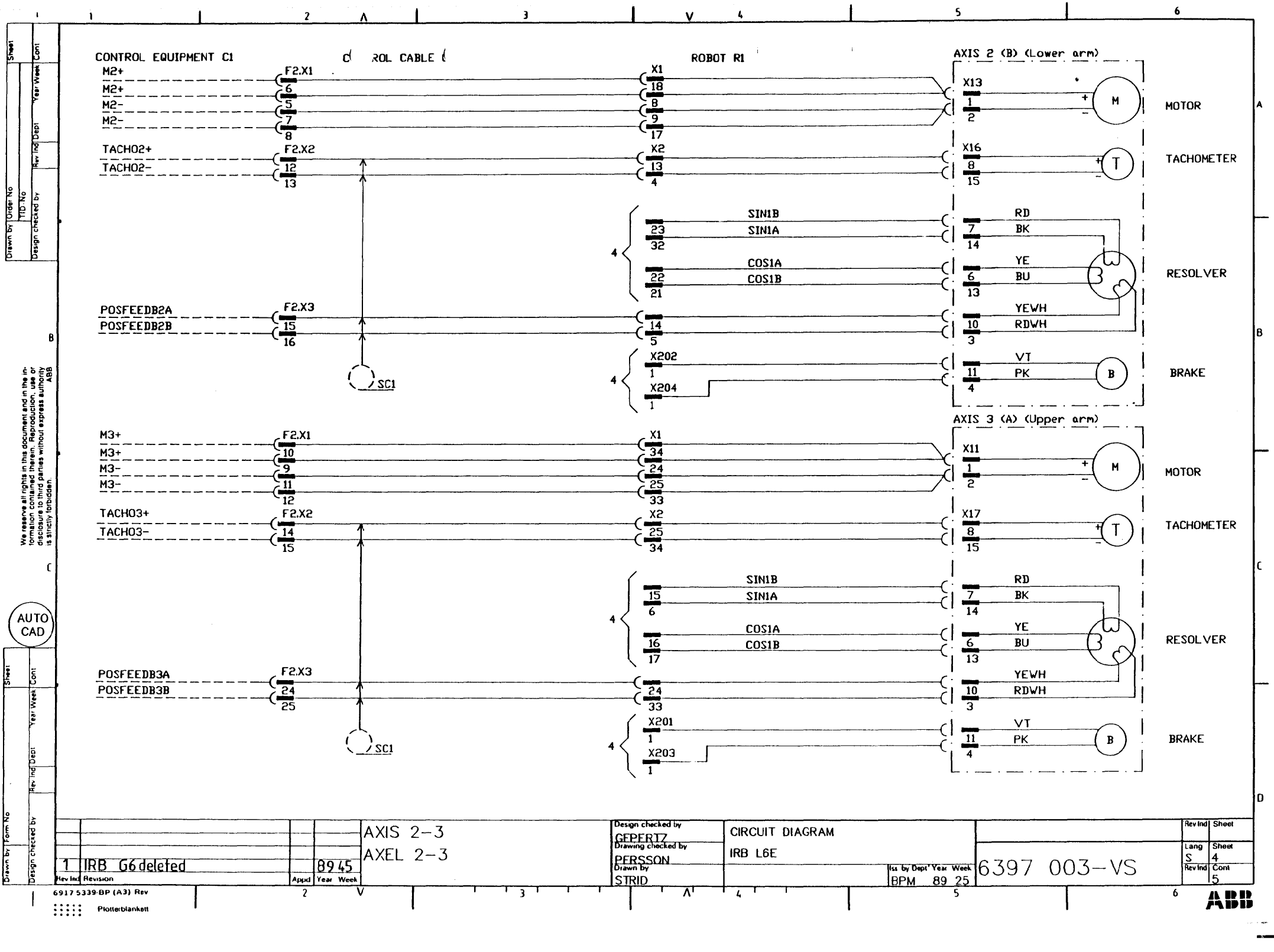

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Rev Ind	Revision	Appd	Year	Week			
1	IRB G6 deleted		89	45	AXIS 2-3 AXEL 2-3	Design checked by: GEPERTZ Drawing checked by: PERSSON Drawn by: STRID	CIRCUIT DIAGRAM IRB L6E Iss by Dept Year Week: BPM 89 25

6397 003-VS

Rev Ind: 5 | Sheet: 4 | Lang: S | Cont: 5

6917 5339-BP (A3) Rev

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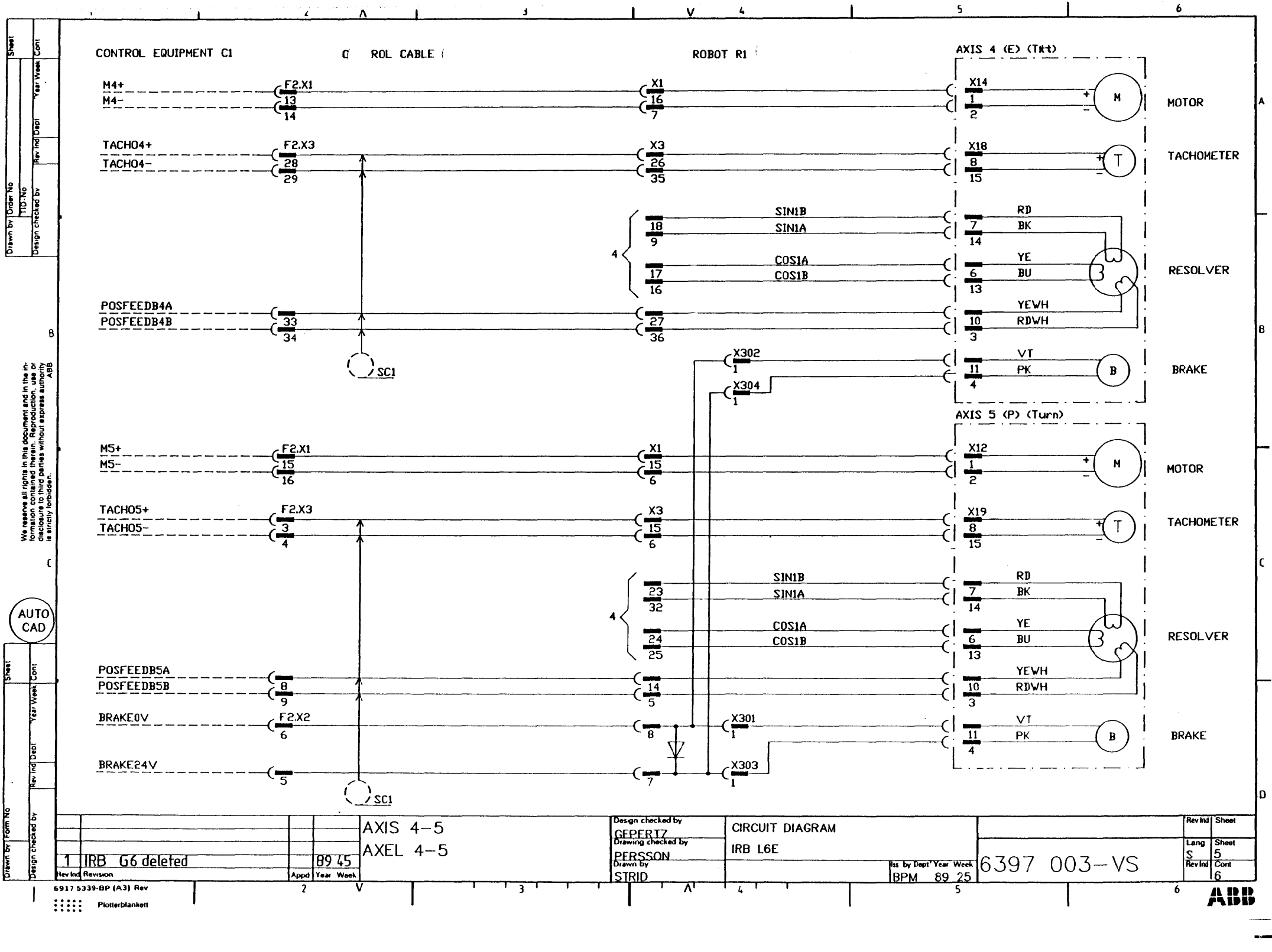
CONTROL EQUIPMENT C1
CONTROL CABLE
ROBOT R1
AXIS 4 (E) (Tilt)
M4+
M4-
F2.X1
13
14
X1
16
7
X14
1
2
MOTOR
TACHO4+
TACHO4-
F2.X3
28
29
X3
26
35
X18
8
15
TACHOMETER
SIN1B
SIN1A
COS1A
COS1B
18
9
17
16
4
RD
BK
YE
BU
7
14
6
13
RESOLVER
POSFEEDB4A
POSFEEDB4B
33
34
27
36
YEWH
RDWH
10
3
SC1
X302
1
X304
1
VT
PK
11
4
BRAKE
AXIS 5 (P) (Turn)
M5+
M5-
F2.X1
15
16
X1
15
6
X12
1
2
MOTOR
TACHO5+
TACHO5-
F2.X3
3
4
X3
15
6
X19
8
15
TACHOMETER
SIN1B
SIN1A
COS1A
COS1B
23
32
24
25
4
RD
BK
YE
BU
7
14
6
13
RESOLVER
POSFEEDB5A
POSFEEDB5B
8
9
14
5
YEWH
RDWH
10
3
BRAKE0V
F2.X2
6
8
X301
1
VT
PK
11
4
BRAKE
BRAKE24V
5
7
X303
1
SC1
AUTO CAD
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TID No
Design checked by
Rev Ind
Dept
Year Week
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Sheet
Form No
AXIS 4-5
AXEL 4-5
1 IRB G6 deleted
Rev Ind Revision
Appd
89 45
Year Week
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GEPERTZ
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PERSSON
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STRID
CIRCUIT DIAGRAM
IRB L6E
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BPM 89 25
6397 003-VS
Rev Ind
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Sheet
5
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6
6917 5339-BP (A3) Rev
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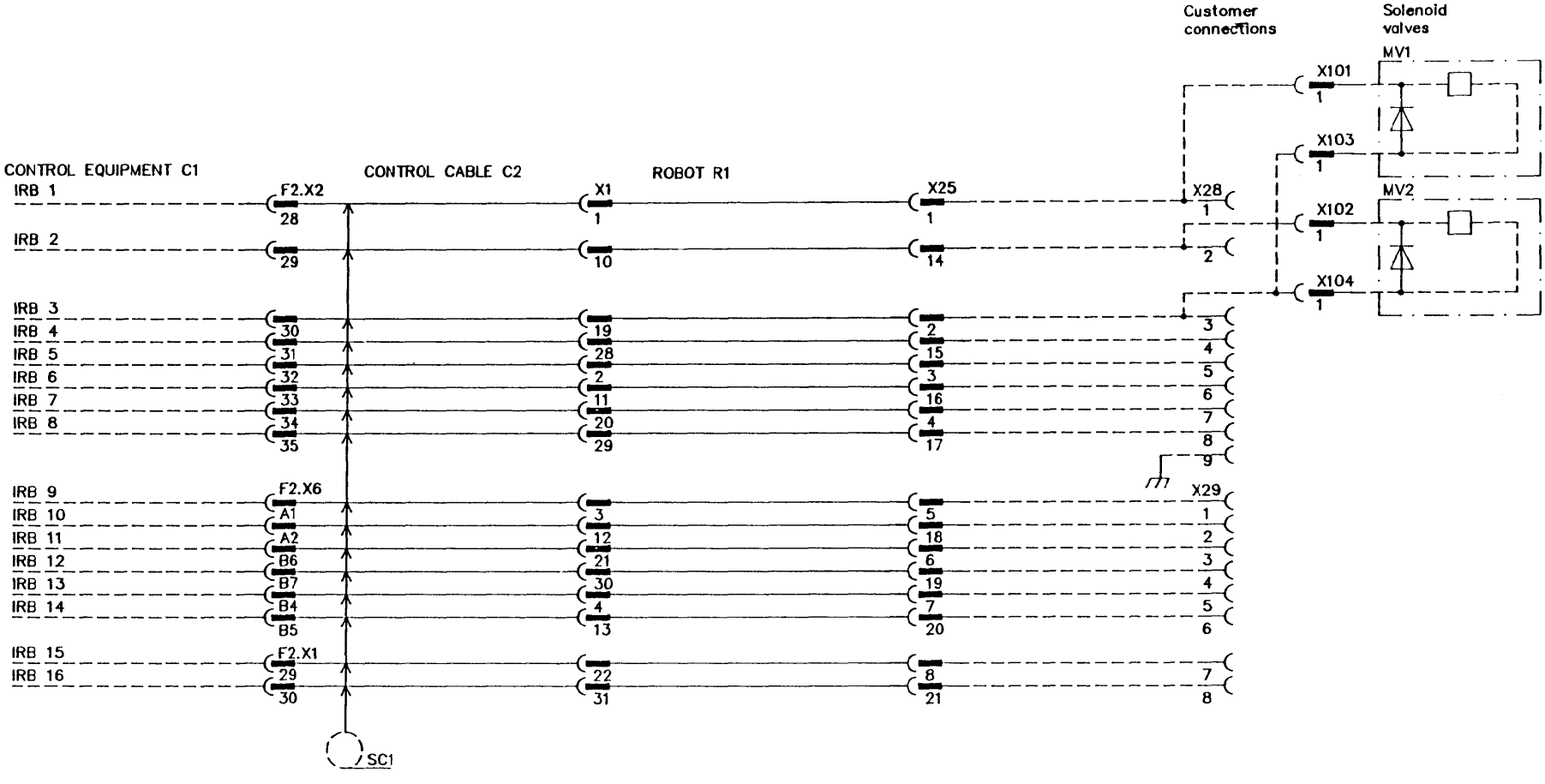
ABB



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1	IRB G6 deleted		89	45

CUSTOMER CONNECTIONS
KUNDANSLUTNINGAR

Design checked by: GEPERTZ
Drawing checked by: PERSSON
Drawn by: STRID

CIRCUIT DIAGRAM
IRB L6E

Iss by Dept Year Week: BPM 89 25

6397 003-VS

Rev Ind: 1 | Sheet: 7
Lang: S | Sheet: 6
Rev Ind | Cont

6917 5339-BP (A3) Rev
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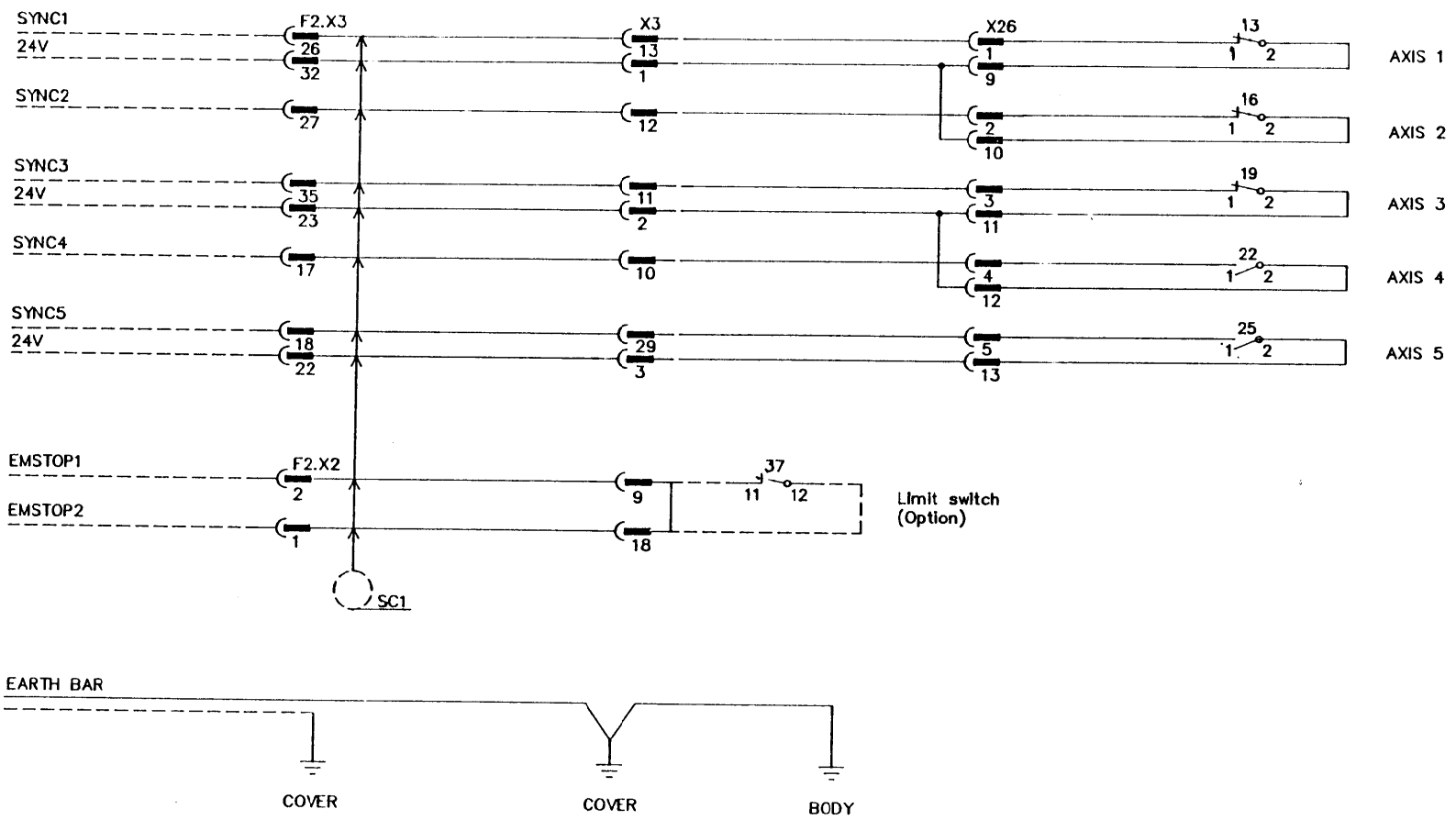
ABB



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			SYNC SWITCHES, LIM SW SYNK BRYT, GRÄNSL BRYT	Design checked by GEPERTZ Drawing checked by PERSSON Drawn by STRID	CIRCUIT DIAGRAM IRB L6E		Rev Ind | Sheet
1	IRB G6 deleted		89 45			6397 003-VS	Lang S | Sheet 7 Rev Ind | Cont –
Rev Ind	Revision	Ajpxl	Year Week		Iss by Dept Year Week BPM 89 25		

6917 5339-BP (A3) Rev

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ABB

SHEET	CONTENTS
1	LIST OF CONTENTS
2	VIEW OF CONTROL CABINET
3	BLOCK DIAGRAM
3.7	JUMPERS ON CIRCUIT BOARDS
10	MAIN POWER CONNECTION
11	POWER DISTRIBUTION
12	ELECTRONIC POWER DISTRIBUTION
13	EMERGENCY STOP LOOP
14	CONTROL PANEL AND BASIC IN/OUTPUTS
15	PROGRAMMING UNIT ANG FLOPPY-DISC UNIT
16	DRIVE UNITS AXES 1,2,3
17	R/D AND D/A CONVERTER AXES 1,2,3
18	DRIVE UNITS AXES 4,5
19	R/D AND D/A CONVERTER AXES 4,5
20	AXIS CONTROL FOR AXIS 6
21	DRIVE UNITS AXES 7,8,9
22	R/D AND D/A CONVERTIR AXES 7,8,9
23	DIGITAL IN/OUTPUTS 24 V D.C. DSDX 110
24	DIGITAL INPUTS 24V D.C DSDI 110

SHEET	CONTENTS	
25	DIGITAL INPUTS 110 V AC	DSDI 130
26	DIGITAL OUTPUTS 24V	DSDO 110
27	DIGITAL OUTPUTS RELAY	DSDO 131
28	ANALOG INPUTS	DSAI 120
29	ANALOG OUTPUTS	DSAO 110
30	DATA TERMINAL AND COMPUTER LINK CONNECTION	
31	DEAD MANS HANDLE	
33	MONITOR CONNECTION	DSQC 121
34	SUPERVISION BOARD AXES 1-3	DSQC 142
35	SUPERVISION BOARD AXES 4-6	DSQC 142
36	SUPERVISION BOARD AXES 7-9	DSQC 142

ATTENTION
IN THIS CIRCUIT DIAGRAM ARE NOT ALL FUNCTIONS INCLUDED
CIRQUIT DIAGRAMS FOR THESE ARE TO BE FOUND IN SEPARATE
DOCUMENTS FOR RESP OPTIONAL FUNCTION

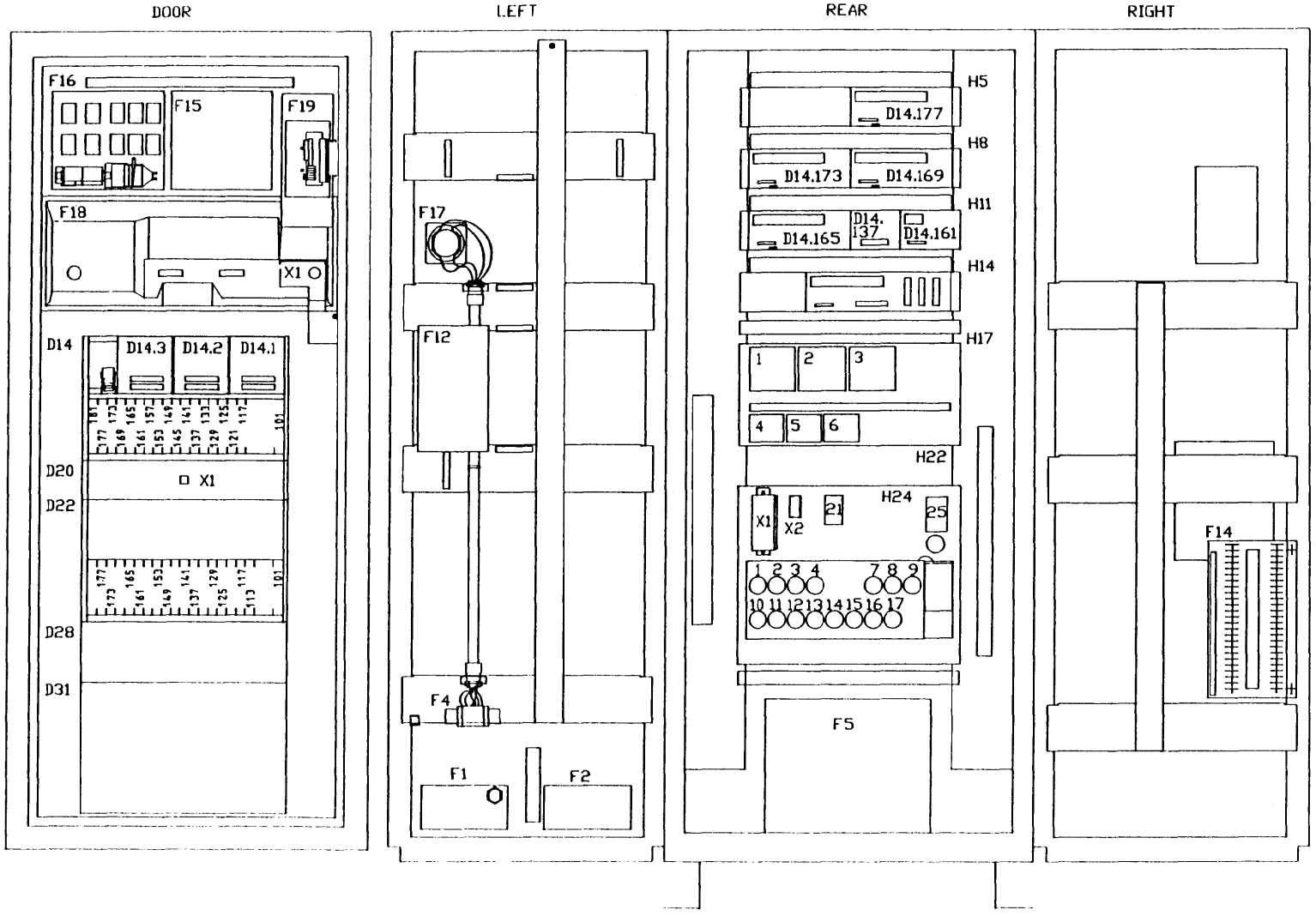
PRIMARY PART IN ARCADE

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK
CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Rel by Dept Year Week: ROB/BCS 89 37
6704 600-ARA
Rev Ind | Sheet 1 | SV | Cont 2

Rev Ind Revision | Appd | Year Week

8917 5339-AA (A3) Rev

INSIDE



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Rev Ind	Revision	Appd	Year Week	VIEW OF CONTROL CABINET	Design checked by MYKLEBUST Drawing checked by LINDSTRÖM Drawn by LL/AK	CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2 Iss by Dept Year Week BCS 89 37	6704 600-ARA	Rev Ind Sheet Lang Sheet 2 Rev Ind Cont 3

6917 5339-8P (A3) Rev

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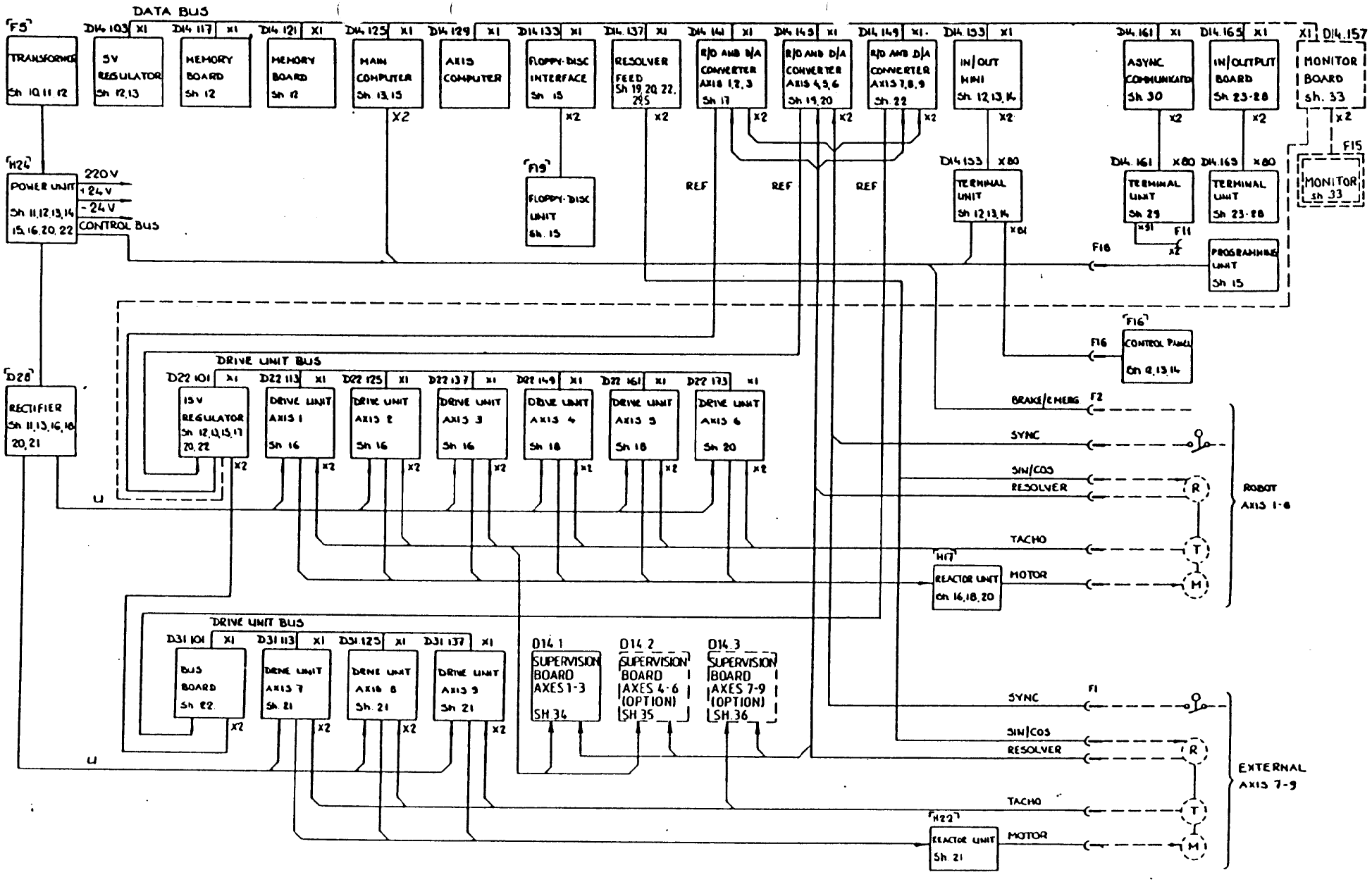

PRIMARY PART IN ARCADE

BLOCK DIAGRAM

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Rev Ind | Revision | Appd | Year Week

6704 600-ARA

Rev Ind: SV | Sheet: 3 | Cont: 3.7

6917 5338-AA (A3) Rev

D14.1

DSQC 142 SUPERVISION BOARD AXES 1-3				
1. TACHO VOLTAGE		3V/1000 rpm		6V/1000 rpm
AXIS 1	S1:1-2	☒	NO JUMPER	☐
AXIS 2	S2:1-2	☒	NO JUMPER	☐
AXIS 3	S3:1-2	☒	NO JUMPER	☐
2. MODE				
S4 NO JUMPER		☒	NORMAL OPERATION	
S5 : 1-2		☒	NORMAL OPERATION	

D14.2

DSQC 142 SUPERVISION BOARD AXES 4-6 (OPTION)				
1. TACHO VOLTAGE [1]		3V/1000 rpm		6V/1000 rpm
AXIS 4	S1:1-2	☐	NO JUMPER	☐
AXIS 5	S2:1-2	☐	NO JUMPER	☐
AXIS 6	S3:1-2	☐	NO JUMPER	☐
2. MODE				
S4 NO JUMPER		☒	NORMAL OPERATION	
S5 : 1-2		☒	NORMAL OPERATION	

D14.3

DSQC 142 SUPERVISION BOARD AXES 7-9 (OPTION)				
1. TACHO VOLTAGE [1]		3V/1000 rpm		6V/1000rpm
AXIS 7	S1:1-2	☐	NO JUMPER	☐
AXIS 8	S2:1-2	☐	NO JUMPER	☐
AXIS 9	S3:1-2	☐	NO JUMPER	☐
2. MODE				
S4 NO JUMPER		☒	NORMAL OPERATION	
S5 : 1-2		☒	NORMAL OPERATION	

1) NOTE: S1,S2 AND S3 ARE STRAPPED ON OPTIONAL SUPERVISION BOARDS. STRAPS MUST BE REMOVED ON INSTALLATION WITH 6V TACHO. OTHERWISE INTERMITTANT ROBOT STOP CAN OCCUR DUE TO THE LARGE DIFFERENCE IN RESOLVER AND TACHO SIGNALS.

PRIMARY PART IN ARCADE

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

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Rev Ind | Sheet: 3.7
SV | Cont: 4

Rev Ind | Revision | Appd | Year Week

6917 6339-AA (A3) Rev

ABB ARBE

D 14.125

DSPC 157 Main single-board computer	
1. Memory address field S6 : 1-2 S13 : 2-3, 5-6, 8-9, 17-18	☒ Memories on the board ☒ 0-512 kbytes
2. Memory type S10 : 1-3, 5-6, 11-12 S20 : 1-3, 5-6, 11-12	☒ EPROM 27256 ☒ EPROM 27256
3. Back-up voltage S5 : 1-2, 3-5, 4-6	☒ None
4. Access time S12 : 3-4	☒ 2 Wait-states
5. Mode S2 : 3-4 X9 : 1-2	☒ Normal operation ☒ Normal operation
6. Inhibit-N S11 : 1-2 Shall be removed	

Attention!. The jumpers which are not marked must be placed according to the actual options which are included in the system

Other jumper groups are not to be used

The pin marked "1" on the short side of the straps groups is the first pin

PRIMARY PART IN ARCADE

JUMPERS ON MAIN COMPUTER

Design checked by E MYKLEBUST
Drawing checked by C LINDSTRÖM
Drawn by LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Ins by Dept' Year Week ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet 4
SV | Cont 4, 5

Rev Ind | Reason | Appd | Year Week

Drawn by | Order No. | Rev Ind | Dept | Year Week | Sheet | Cont
Design checked by | TID-No. | Form No.

D14 121

DSMB 127 PROM/RW memory board		
1 Memory address field		
S1: 2-3, 4-5, 7-8, 10-11, 14-15, 17-18, 20-21, 23-24	[X]	896k - 960k bytes
S100: 5-6, 8-9, 11-12		
3 Back-up voltage		
S2: 1-2, 3-4, 5-6, 7-8, 9-10, 11-12	[X]	Internal on
S6: 1-2	[X]	External on
4 Access time		
S4 1-2	[X]	Quick acknowledge activated

D14 117

DSMB 127 PROM/RW memory board		
1 Memory address field		
S1: 1-2, 4-5, 7-8, 10-11, 14-15, 17-18, 20-21, 23-24	[X]	960k - 1024kbytes
S100: 5-6, 8-9, 11-12		
3 Back-up voltage		
S2: 1-2, 3-4, 5-6, 7-8, 9-10, 11-12	[X]	Internal on
S6: 1-2	[X]	External on
4 Access time		
S4 1-2	[X]	Quick acknowledge activated

PRIMARY PART IN ARCADE

JUMPERS ON MEMORY BOARDS

Design checked by E MYKLEBUST
Drawing checked by C LINDSTRÖM
Drawn by LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
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Rev Ind Sheet 4,5
SV Cont 5

6917 6339-AA (A3) Rev

「D14 129」

DSPA 110 Axis slave computer		
1. I/O address		
S1: 1-2, 5-6, 8-9, 10-11	[X]	$ 29
14-15, 16-17, 20-21, 23-24		
2. Memory type		
S6: 1-2, 3-4	[X]	RW 6116
S5: 1-3, 5-6	[X]	EPROM 2764
3. Access time		
S4: 3-4	[X]	1 wait-state
S3: 1-2	[X]	0 wait-state area 3
4. Mode		
S2: 7-9	[X]	Normal
S7: 1-2	[X]	Normal

「D14.137」

DSQC 115 Resolver feed and two D/A (Option)		
1/O address		
S1: 1-2, 4-5, 7-8, 11-12	[X]	$ 37
13-14, 16-17, 20-21, 23-24		

「D14.141」

DSQC 129 R/D and D/A converter Axis 1,2,3		
1. I/O address		
S1: 1-2, 5-6, 8-9, 11-12	[X]	$ 41
14-15, 17-18, 19-20, 23-24		
2. Measuring channels		
X4: 21-23, 22-24	[X]	Axis 1,2,3

「D14.145」

DSQC 129 R/D and D/A converter Axis 4,5,6		
1 I/O address		
S1: 1-2, 5-6, 7-8, 11-12	[X]	$ 45
14-15, 17-18, 19-20, 23-24		
2 Measuring channels		
X4: 21-23, 24-26	[ ]	Axis 4,5
X4: 21-23, 22-24	[ ]	Axis 4,5,6 (Option)

「D14.149」

DSQC 129 R/D and D/A converter Axis 7,8,9 (Option)		
1 I/O address		
S1: 1-2, 5-6, 8-9, 10-11	[X]	$ 49
14-15, 17-18, 19-20, 23-24		
2 Measuring channels		
X4: 23-25, 24-26	[ ]	Axis 7 (Option)
X4: 21-23, 24-26	[ ]	Axis 7,8 (Option)
X4: 21-23, 22-24	[ ]	Axis 7,8,9 (Option)

PRIMARY PART IN ARCADE

JUMPERS ON AXIS CONTROL BOARDS

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Drawing checked by C LINDSTRÖM
Drawn by LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
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6704 600-ARA

Rev Ind | Sheet 5
SV | Cont 6

6917 5339-AA (A3) Rev

D14 133

DSMC 110 Floppy-disc interface		
1. I/O address		
S1: 1-2, 4-5, 8-9, 11-12 13-14, 16-17, 20-21, 23-24	[X]	$ 33
2 Density, write pulse adjustment and mode		
S2: 1-2, 3-4	[X]	Normal
S3: 1-2	[X]	Normal
S4: 1-2	[X]	Normal

D14.153

DSDX 110 I/O-mini		
1. I/O address		
S1: 1-2, 4-5, 8-9, 11-12 13-14, 17-18, 19-20, 23-24	[X]	$ 53
2. Mode		
X3: 37-38, 39-40	[X]	Normal

D14.161

DSCA 114 Asynchronous communication module (Option)		
1. I/O-address and interrupt level		
S1: 8-9, 11-12, 14-15, 16-17, 19-20, 23-24	[X]	$ 60
S1: 2-3, 4-5	[X]	Level 2

D14.157

DSQC 121 Monitor board		
Memory address field (8k byte)		
S1: 2-3, 5-6, 8-9, 11-12, 14-15, 17-18, 19-20, 23-24	[X]	By placing the jumpers in different ways it is possible to choose any 8k byte field within 0-2 M byte

PRIMARY PART IN ARCADE

JUMPERS ON I/O BOARDS

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Rev Ind | Revision | Appd | Year Week

Rev Ind | Sheet
Rev Ind | Sheet 6
SV | Cont 7

6704 600-ARA

D14.165

DSDX 110	I/O-mini	(Option)
DSDO 110, 120, 130, 131, 140	Digital outputs	
DSDI 110, 120, 130, 140	Digital inputs	
DSAI 120 2)	Analog inputs	
DSAO 110	Analog outputs	

1. I/O address
   S1: 1-2, 5-6, 7-8, 11-12 [X] $ 65
   14-15, 16-17, 19-20, 23-24

2. Test light diodes on DSAI 120
   S2: 1-2 [X] Off

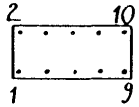
3. Mode on DSDX 110, DSDI 110, 120, 130, 140
   X3: 37-38, 39-40 [X] Normal

4. Function on DSAO 110
   S101, S201, S301, S401: [X] Normal
   1-2, 3-4, 5-6, 7-8

5. Mode on DSAO 110 1)
   S102, S202, S302, S402
   1-2, 5-6 [ ] 0 - ± 10V
   1-2, 7-8 [ ] 0 - ± 10mA
   1-2, 7-8 [ ] 0 - ± 20mA

6. Mode on DSAO 110
   Solder strap W106, W206, W306, W406
   connected [ ] 0 - ± 10V
   not connected [ ] 0 - ± 10mA
   connected [ ] 0 - ± 20mA

1) Strap group orientation for mode on DSAO 110



D14.169

DSDX 110	I/O-mini	(Option)
DSDO 110, 120, 130, 131, 140	Digital outputs	
DSDI 110, 120, 130, 140	Digital inputs	
DSAI 120 2)	Analog inputs	
DSAO 110	Analog outputs	

1. I/O address
   S1: 1-2, 5-6, 8-9, 10-11 [X] $ 69
   14-15, 16-17, 19-20, 23-24

2. Test light diodes on DSAI 120
   S2: 1-2 [X] Off

3. Mode on DSDX 110, DSDI 110, 120, 130, 140
   X3: 37-38, 39-40 [X] Normal

4 Function on DSAO 110
   S101, S201, S301, S401 [X] Normal
   1-2, 3-4, 5-6, 7-8

5. Mode on DSAO 110 1)
   S102, S202, S302, S402
   1-2, 5-6 [ ] 0 - ± 10V
   1-2, 7-8 [ ] 0 - ± 10mA
   1-2, 7-8 [ ] 0 - ± 20mA

6. Mode on DSAO 110
   Solder strap W106, W206, W306, W406
   connected [ ] 0 - ± 10V
   not connected [ ] 0 - ± 10mA
   connected [ ] 0 - ± 20mA

2) Straps on Terminal unit for DSAI 120 should be removed.
Make sure that the straps don't fall inside the cabinet

Drawn by | Order No. | Design checked by | Rev Ind | Dept | Year Week | Sheet | Cont

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PRIMARY PART IN ARCADE

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JUMPERS ON I/O BOARD

Design checked by: E MYKLEBUST
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CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Init by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet: 7 | SV | Cont: 7,5

6917 8338-AA (A3) Rev

1 2 3 4 5 6 A B C D

「D14 173」

DSDX 110	I/O - mini	OPTION
DSDO 110, 120, 130, 131, 140	Digital outputs	
DSDI 110, 120, 130, 140	Digital inputs	
DSAO 110	Analog outputs	

1. I/O address
   S1: 1-2, 4-5, 8-9, 11-12
   13-14, 16-17, 19-20, 23-24
   [X] $73

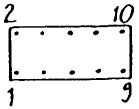
2. Mode on DSDX 110, DSDI 110, 120, 130, 140
   X3: 37-38, 39-40
   [X] Normal

3. Function on DSAO 110
   S101, S201, S301, S401
   1-2, 3-4, 5-6, 7-8
   [X] Normal

4. Mode on DSAO 110 1)
   S102, S202, S302, S402
   1-2, 5-6 [ ] 0 - ± 10V
   1-2, 7-8 [ ] 0 - ± 10mA
   1-2, 7-8 [ ] 0 - ± 20mA

5. Mode on DSAO 110
   Solder strap W106, W206, W306, W406
   connected [ ] 0 - ± 10V
   not connected [ ] 0 - ± 10mA
   connected [ ] 0 - ± 20mA

1) Strap group orientation for mode on DSAO 110



「D14 177」

DSDX 110	I/O - mini	OPTION
DSDO 110, 120, 130, 131, 140	Digital outputs	
DSDI 110, 120, 130, 140	Digital inputs	

1. I/O address
   S1: 1-2, 4-5, 7-8, 11-12
   13-14, 16-17, 19-20, 23-24
   [X] $77

2. Mode on DSDX 110, DSDI 110, 120, 130, 140
   X3: 37-38, 39-40
   [X] Normal

PRIMARY PART IN ARCADE

JUMPERS ON I/O BOARDS

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

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6704 600-ARA

Rev Ind: SV
Sheet: 7.5
Cont: 8

Rev Ind | Revision | Appd | Year Week

6917 5338-AA (A3) Rev

D22.113

YYT 102D/YYT 102 N [1]	Control board with tacho	Axis 1
1. Overload		
S1:7-8	☒ 6,5 A,	

D22.125

YYT 102 D	Control board with tacho	Axis 2
1. Overload		
S1:7-8	☒ 6,5 A,	
S1:1-2 [2]	☒ 8 A	

D22.137

YYT 102 D	Control board with tacho	Axis 3
1. Overload		
S1:7-8	☒ 6,5 A	
S1:1-2 [2]	☒ 8 A	

D22.149

YYT 102 E	Control board with tacho	Axis 4
1. Overload		
S1:7-8	☒ 6,5 A,	

D22.161

YYT 102 E	Control board with tacho	Axis 5
1. Overload		
S1:7-8	☒ 6,5A,	

1) YYT 102 N ONLY FOR IRB G6/2

2) ONLY FOR IRB L6, 66 WITH MOTOR TYPE F12 M4

PRIMARY PART IN ARCADE

JUMPERS ON DRIVE UNITS

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
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CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

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Ins by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: SV
Sheet: 8
Cont: 9

Rev Ind | Revision | Appd | Year Week

6917 6339-AA (A3) Rev

D22 173

YYT 102K Control board with tacho. IRB axis 6 (Option)	
YYT 102A Control board with tacho. External axis 6 (Option)	
1. Overload	
S1: 9-10	☐ 2A, IRB
S1: 7-8	☐ 6.5A, External small motor
S1: 1-2	☐ 8A, External large motor

D31 125

YYT 102A Control board with tacho External axis 8 (Option)	
1. Overload	
S1: 7-8	☐ 6.5A External small motor
S1: 1-2	☐ 8A External large motor

D31 113

YYT 102A Control board with tacho External axis 7 (Option)	
1. Overload	
S1: 7-8	☐ 6.5A External small motor
S1: 1-2	☐ 8A External large motor

D31 137

YYT 102A Control board with tacho. External axis 9 (Option)	
1. Overload	
S1: 7-8	☐ 6.5A, External small motor
S1: 1-2	☐ 8A, External large motor

PRIMARY PART IN ARCADE

JUMPERS ON DRIVE UNITS AND CONVERTER

Design checked by E MYKLEBUST
Drawing checked by C LINDSTRÖM
Drawn by LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Rel. by Dept Year Week ROB/BCS 89 37

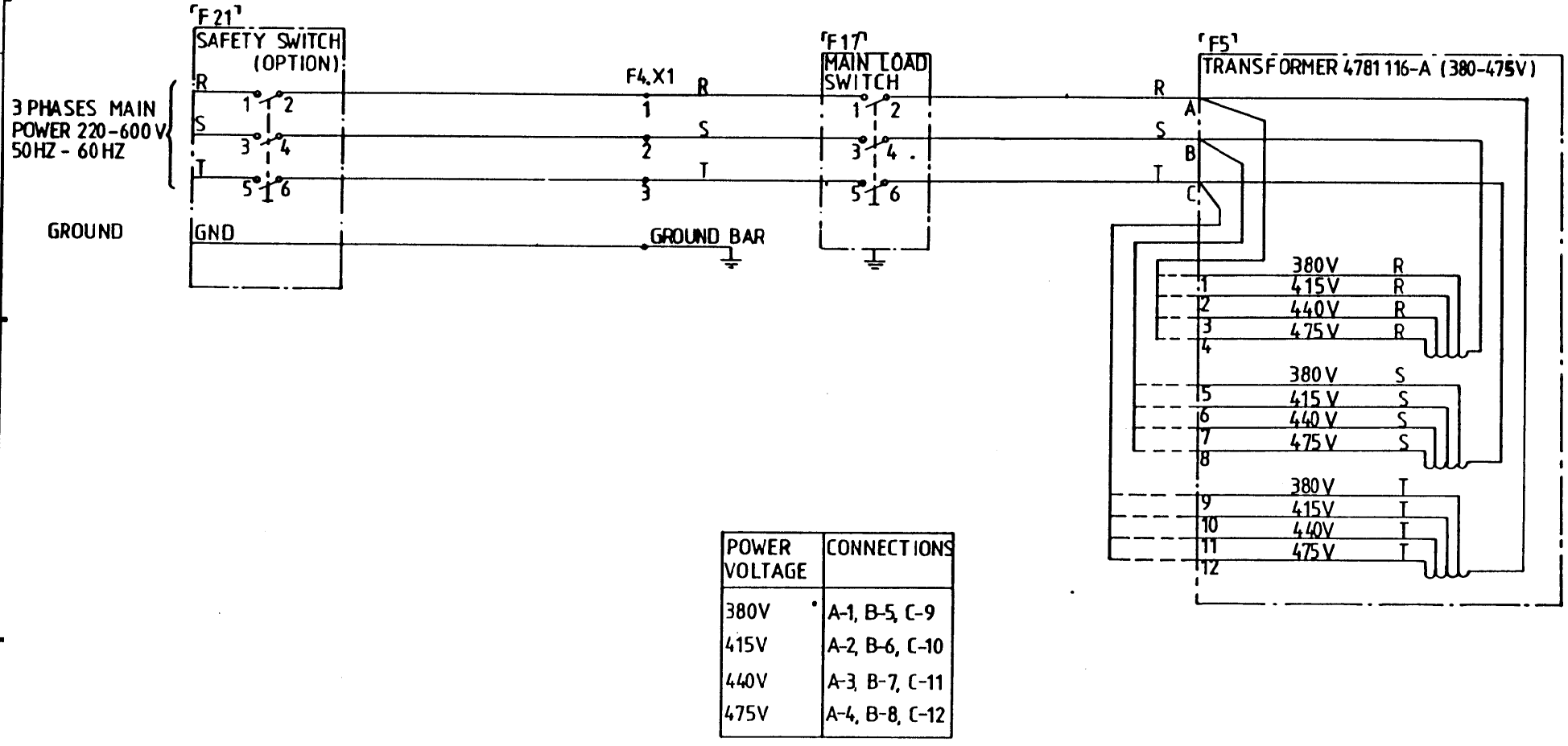
6704 600-ARA

Rev Ind | Sheet 9
SV | Cont 10

Rev Ind | Revision | Appd | Year | Week

6917 5339-AA (A3) Rev

ABB



POWER VOLTAGE	CONNECTIONS
380V	A-1, B-5, C-9
415V	A-2, B-6, C-10
440V	A-3, B-7, C-11
475V	A-4, B-8, C-12

PRIMARY PART IN ARCADE

MAIN POWER CONNECTION

Design checked by: Myklebust
Drawing checked by: Lindström
Drawn by: Björk

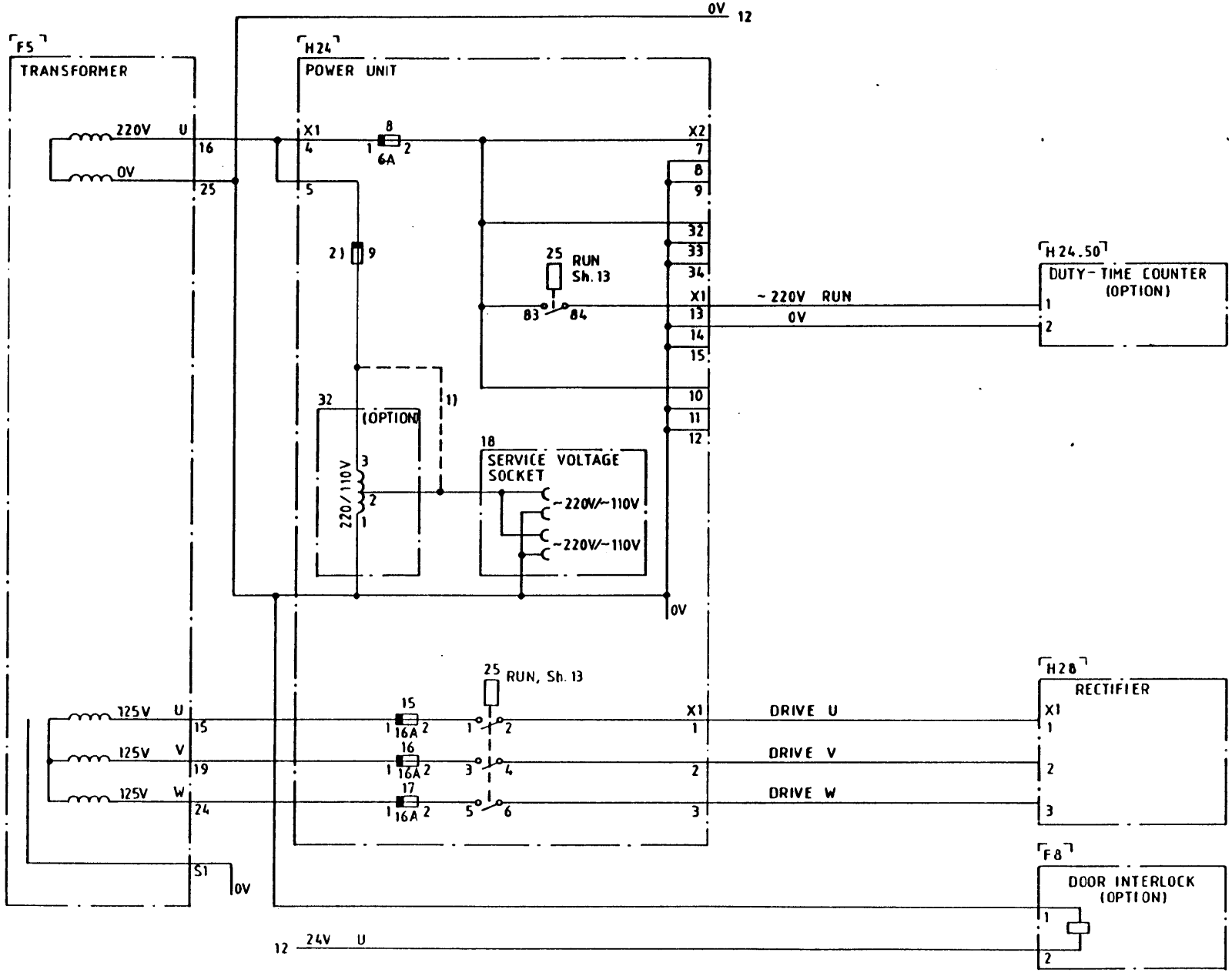
CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Res by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: Sheet
Rev Ind: Sheet 10
SV Cont 11

Rev Ind | Revision | Appd | Year Week

8917 5328-AA (A3) Rev 2



1) CABLE CONNECTION WHEN THE TRANSFORMER 32 (OPTION) IS NOT USED

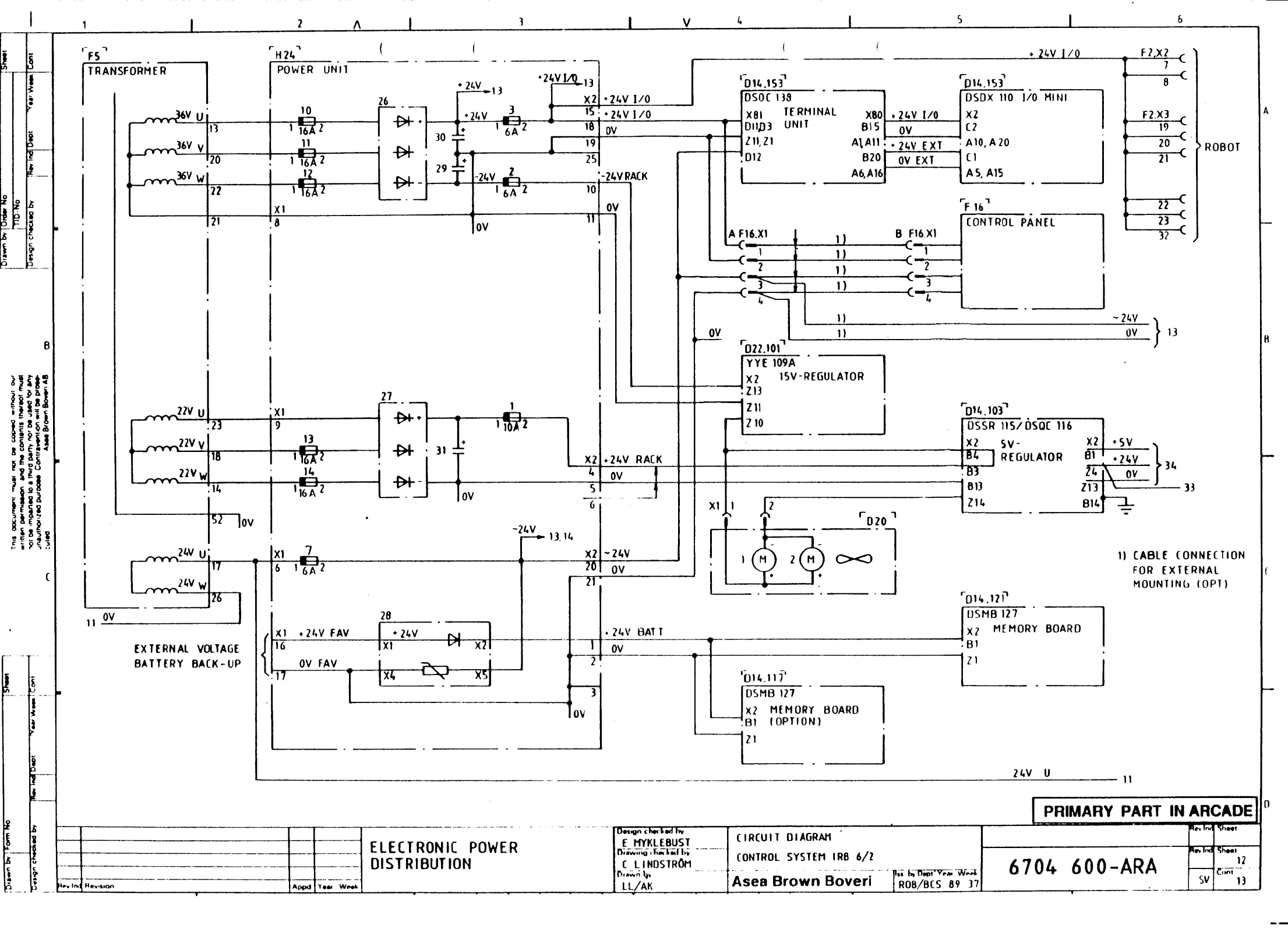
2) FUSE IS 6A WHEN THE TRANSFORMER 32 (OPTION) IS NOT USED. OTHERWISE THE FUSE IS 2A (RED SPOT)

PRIMARY PART IN ARCADE

Rev Ind	Revision	Appd	Year Week	POWER DISTRIBUTION	Design checked by E MYKLEBUST	CIRCUIT DIAGRAM	6704 600-ARA
					Drawing checked by C LINDSTRÖM	CONTROL SYSTEM IRB 6/2	Rev Ind Sheet 11
					Drawn by LL/AK	Asea Brown Boveri	Res by Dept Year Week R08/BCS 89 37
							SV Cont 12

8917 5338-AA (A3) Rev 2

ABB



ELECTRONIC POWER DISTRIBUTION

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

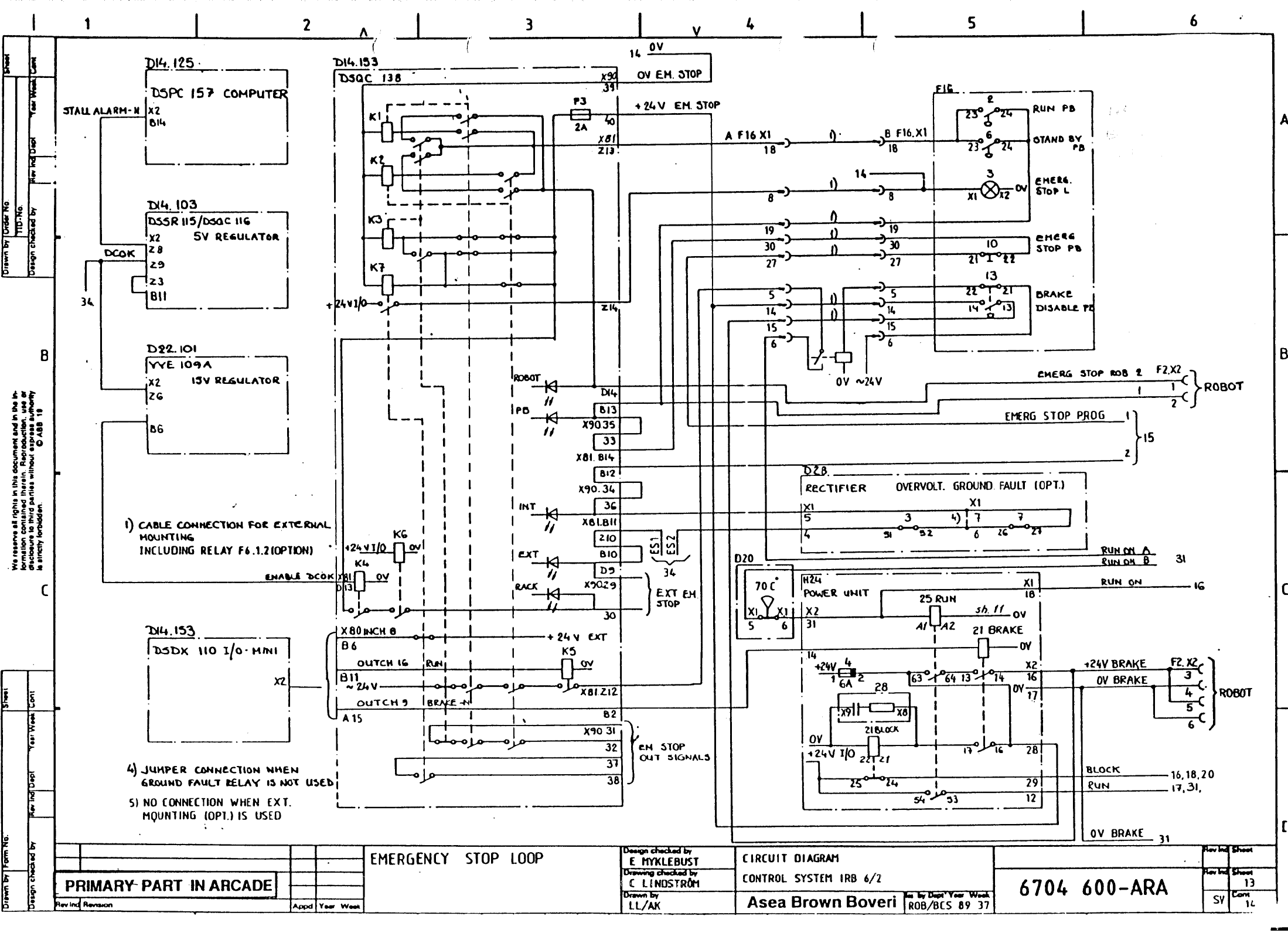
CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

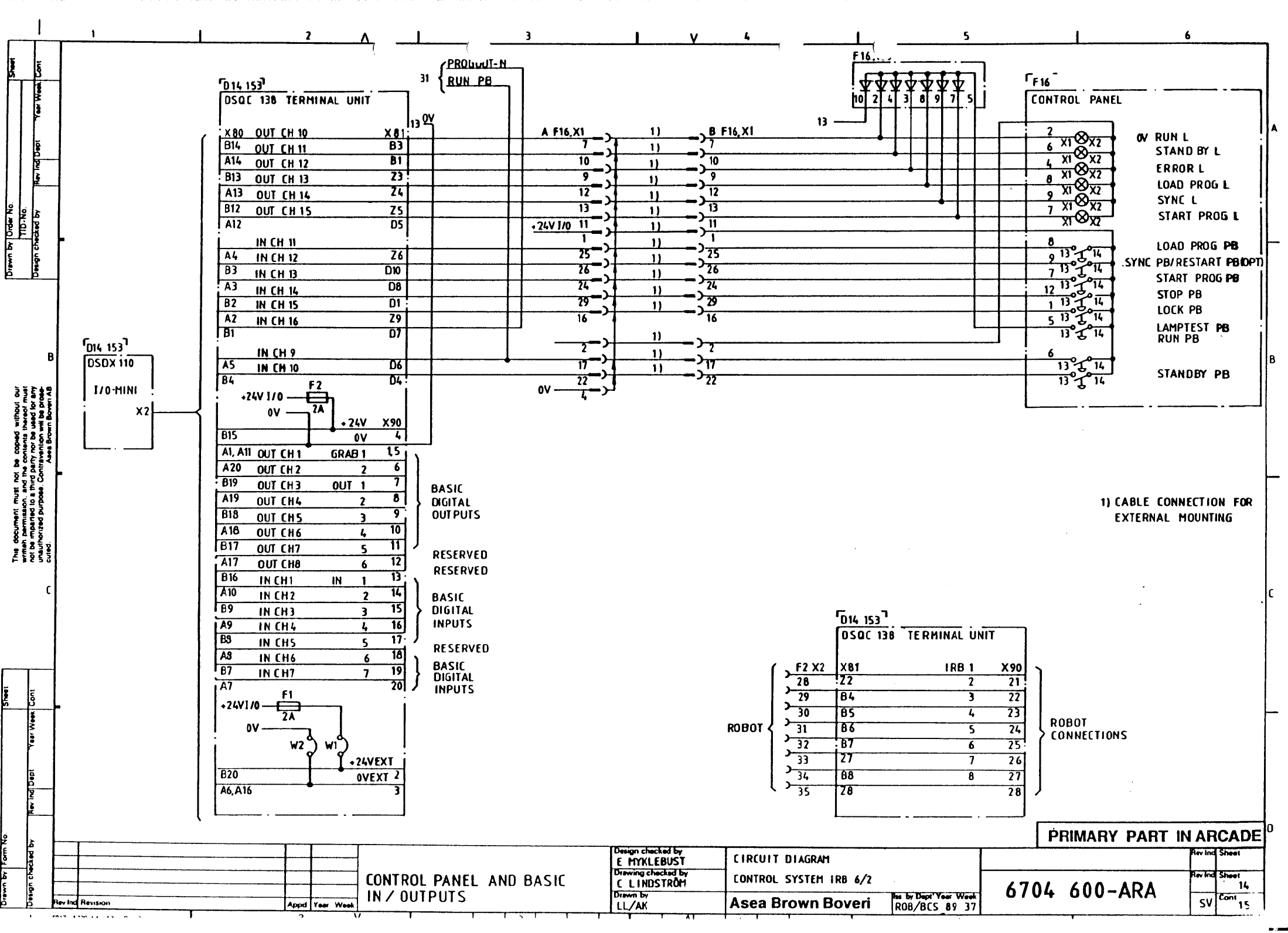
Iss by Dept Year Week: ROB/BCS 89 37

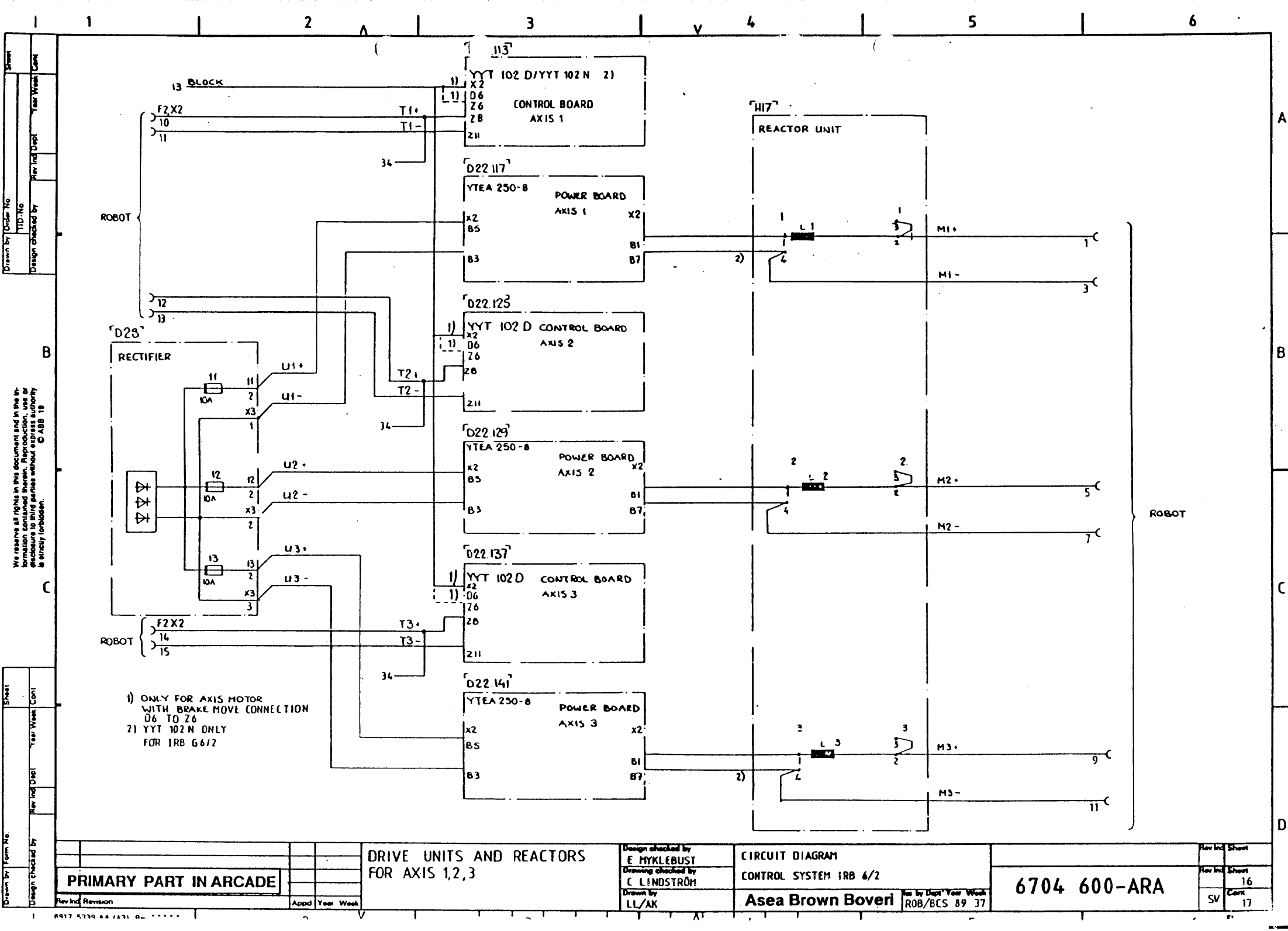
6704 600-ARA

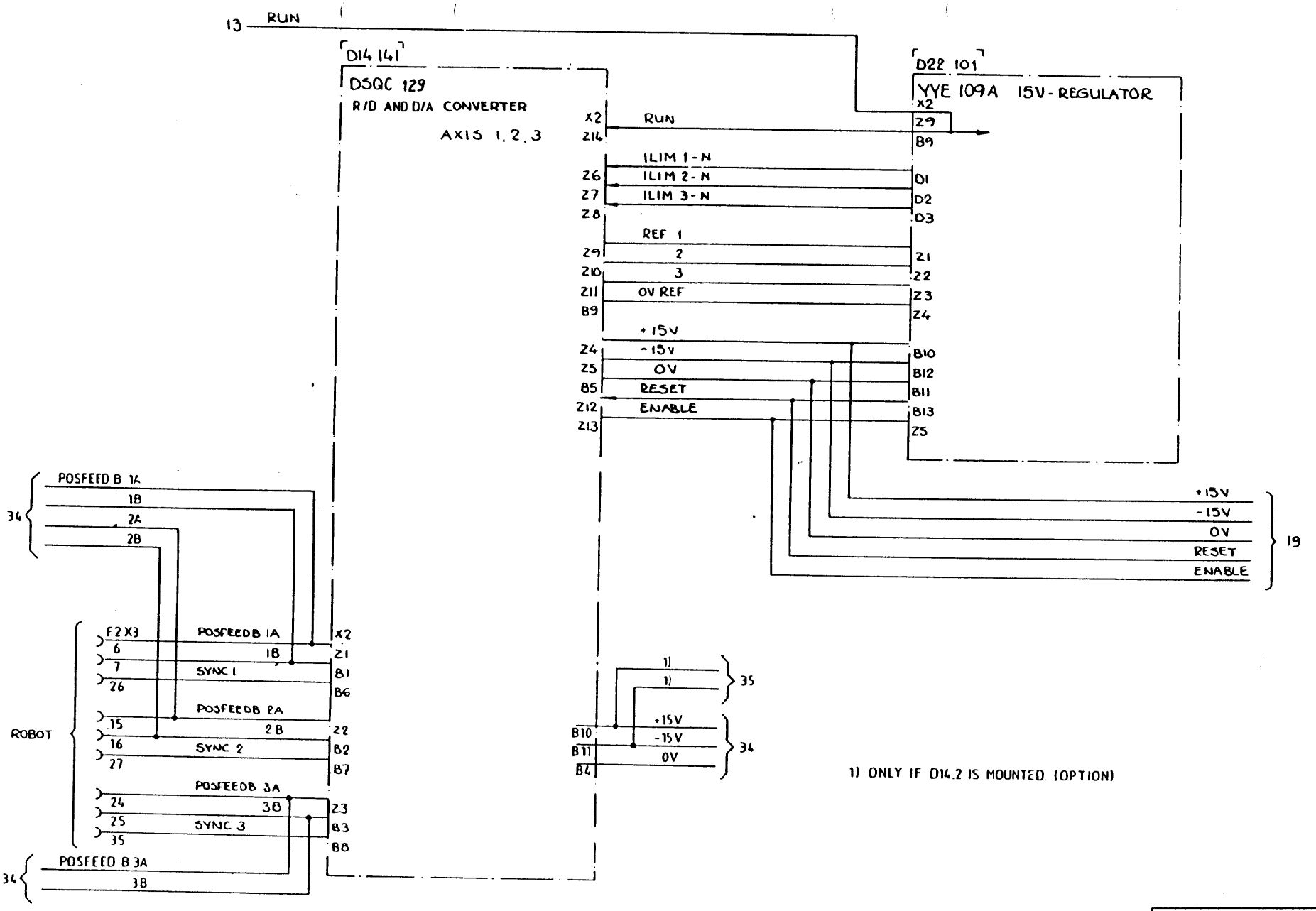
Rev Ind Sheet: 12
Rev Ind Sheet: SV Cont 13



PRIMARY PART IN ARCADE				EMERGENCY STOP LOOP	Design checked by E MYKLEBUST Drawing checked by C LINDSTRÖM Drawn by LL/AK	CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2 Asea Brown Boveri	6704 600-ARA
Rev Ind	Revision	Appd	Year Week			Ins by Dept Year Week ROB/BCS 89 37	Rev Ind SV, Sheet 13, Cont 14




113
YYT 102 D/YYT 102 N 2)
CONTROL BOARD
AXIS 1
13 BLOCK
F2 X2
10
11
T1+
T1-
34
ROBOT
D22 117
YTEA 250-8
POWER BOARD
AXIS 1
H17
REACTOR UNIT
M1+
M1-
12
13
D28
RECTIFIER
U1+
U1-
D22 125
YYT 102 D CONTROL BOARD
AXIS 2
T2+
T2-
D22 129
YTEA 250-8
POWER BOARD
AXIS 2
U2+
U2-
M2+
M2-
ROBOT
D22 137
YYT 102 D CONTROL BOARD
AXIS 3
U3+
U3-
T3+
T3-
F2 X2
14
15
ROBOT
D22 141
YTEA 250-8
POWER BOARD
AXIS 3
M3+
M3-
1) ONLY FOR AXIS MOTOR WITH BRAKE MOVE CONNECTION D6 TO Z6
2) YYT 102 N ONLY FOR IRB 6/2
PRIMARY PART IN ARCADE
DRIVE UNITS AND REACTORS FOR AXIS 1,2,3
Design checked by E MYKLEBUST
Drawing checked by C LINDSTRÖM
Drawn by LL/AK
CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Res by Dept Year Week ROB/BCS 89 37
6704 600-ARA
Sheet 16
Cont 17



PRIMARY PART IN ARCADE

R/D AND D/A CONVERTER FOR AXIS 1,2,3

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

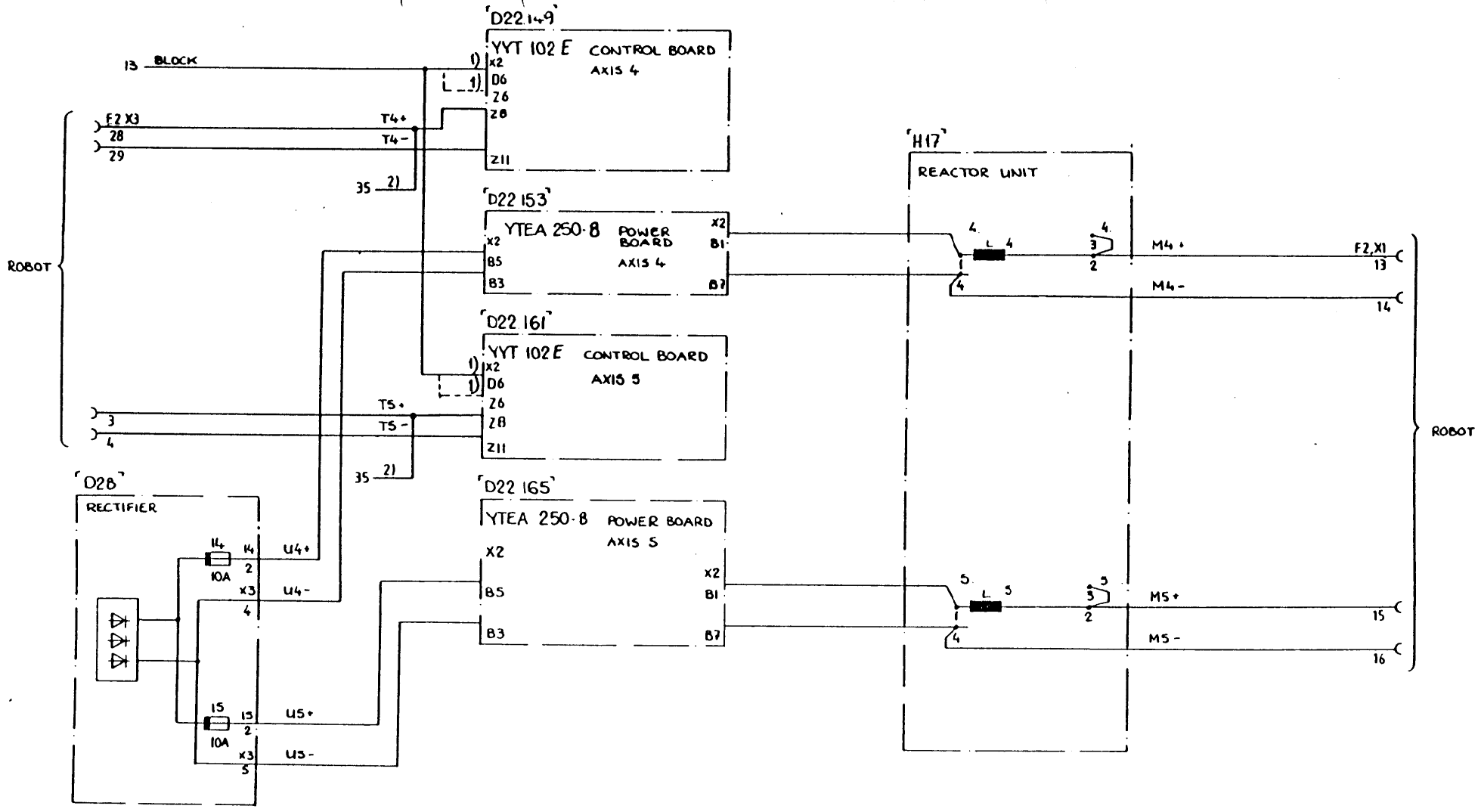
Rev by Dept' Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet: 17
SV | Cont: 18

Rev Ind | Revision | Appd | Year Week

8617 6338-AA (A3) Rev



1) ONLY FOR AXIS MOTOR WITH BRAKE
MOVE CONNECTION D6 TO Z6

21 ONLY IF D14.2 IS MOUNTED. (OPTION)

PRIMARY PART IN ARCADE

DRIVE UNITS AND REACTORS FOR AXIS 4,5

Design checked by E MYKLEBUST
Drawing checked by C LINDSTRÖM
Drawn by LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

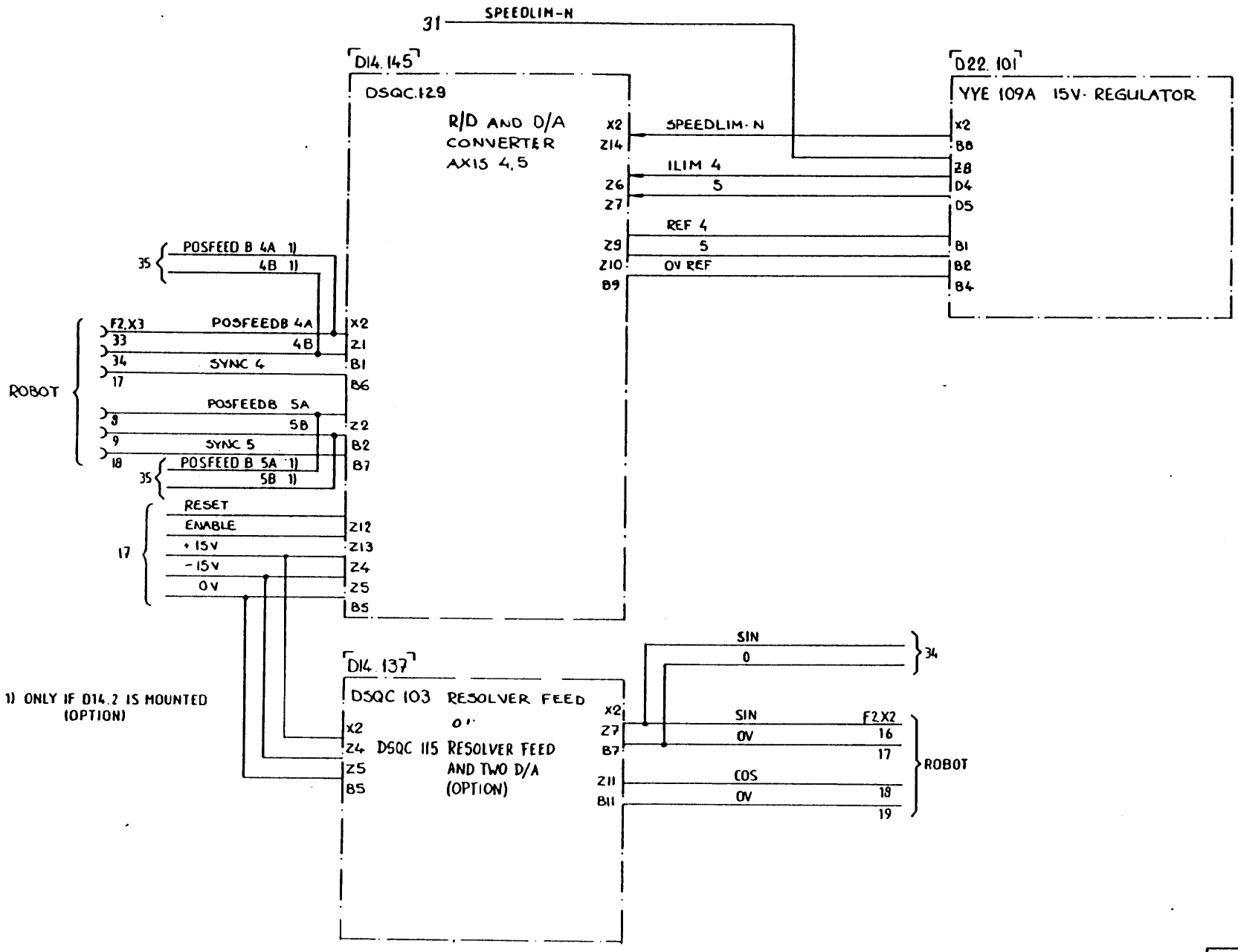
Asea Brown Boveri
Doc by Dept Year Week ROB/BCS 89 37

6704 600-ARA

Rev Ind Sheet 18
SV Cont 19

Rev Ind | Revision | Appd | Year Week

0917 5339-AA (A3) Rev



PRIMARY PART IN ARCADE

R/D AND D/A CONVERTER FOR AXIS 4,5 RESOLVER FEED

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

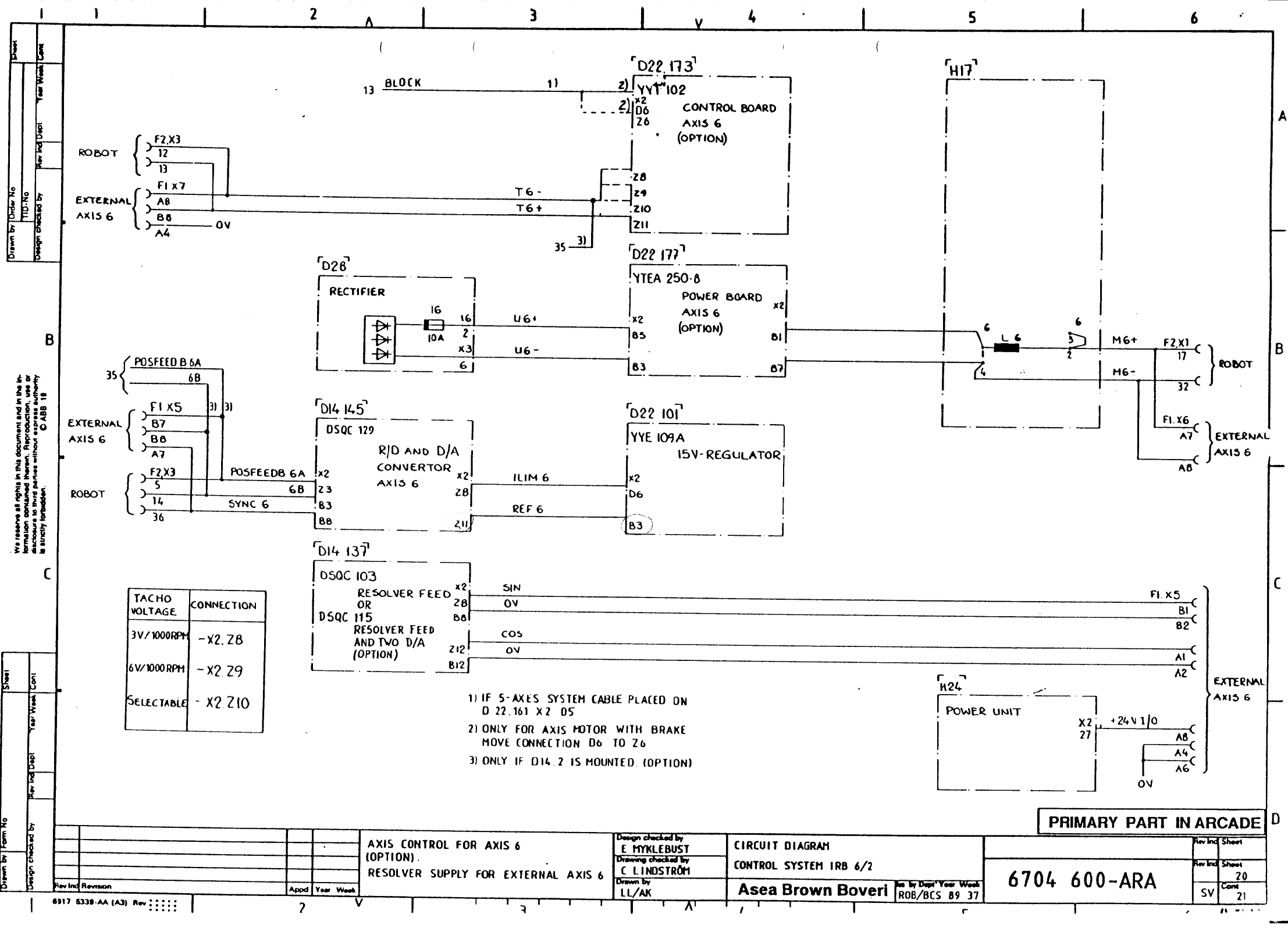
Res. by Dept' Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet: 19
SV | Cont: 20

Rev Ind | Revision | Appd | Year Week

6917 6338-AA (A3) Rev



TACHO VOLTAGE	CONNECTION
3V/1000RPM	-X2.Z8
6V/1000RPM	-X2.Z9
SELECTABLE	-X2.Z10

1) IF 5-AXES SYSTEM CABLE PLACED ON D 22.161 X2 05

2) ONLY FOR AXIS MOTOR WITH BRAKE MOVE CONNECTION D6 TO Z6

3) ONLY IF D14.2 IS MOUNTED. (OPTION)

PRIMARY PART IN ARCADE

AXIS CONTROL FOR AXIS 6 (OPTION).
RESOLVER SUPPLY FOR EXTERNAL AXIS 6

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

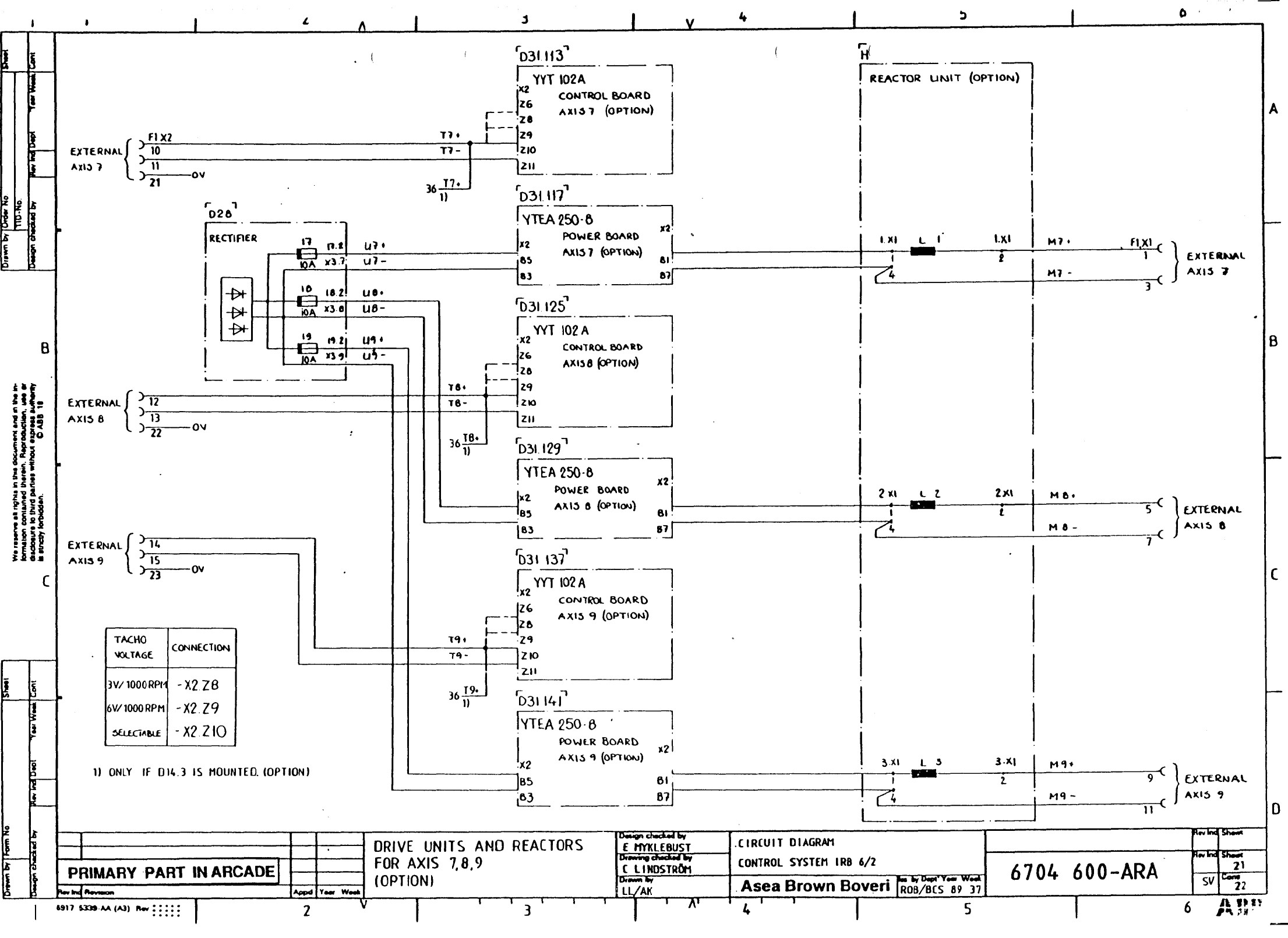
Asea Brown Boveri

ROB/BCS 89 37

6704 600-ARA

Rev Ind: Sheet 20
Rev Ind: SV Cont 21

8917 6339-AA (A3) Rev



TACHO VOLTAGE	CONNECTION
3V/1000 RPM	-X2.Z8
6V/1000 RPM	-X2.Z9
SELECTABLE	-X2.Z10

1) ONLY IF D14.3 IS MOUNTED. (OPTION)

PRIMARY PART IN ARCADE

DRIVE UNITS AND REACTORS FOR AXIS 7,8,9 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

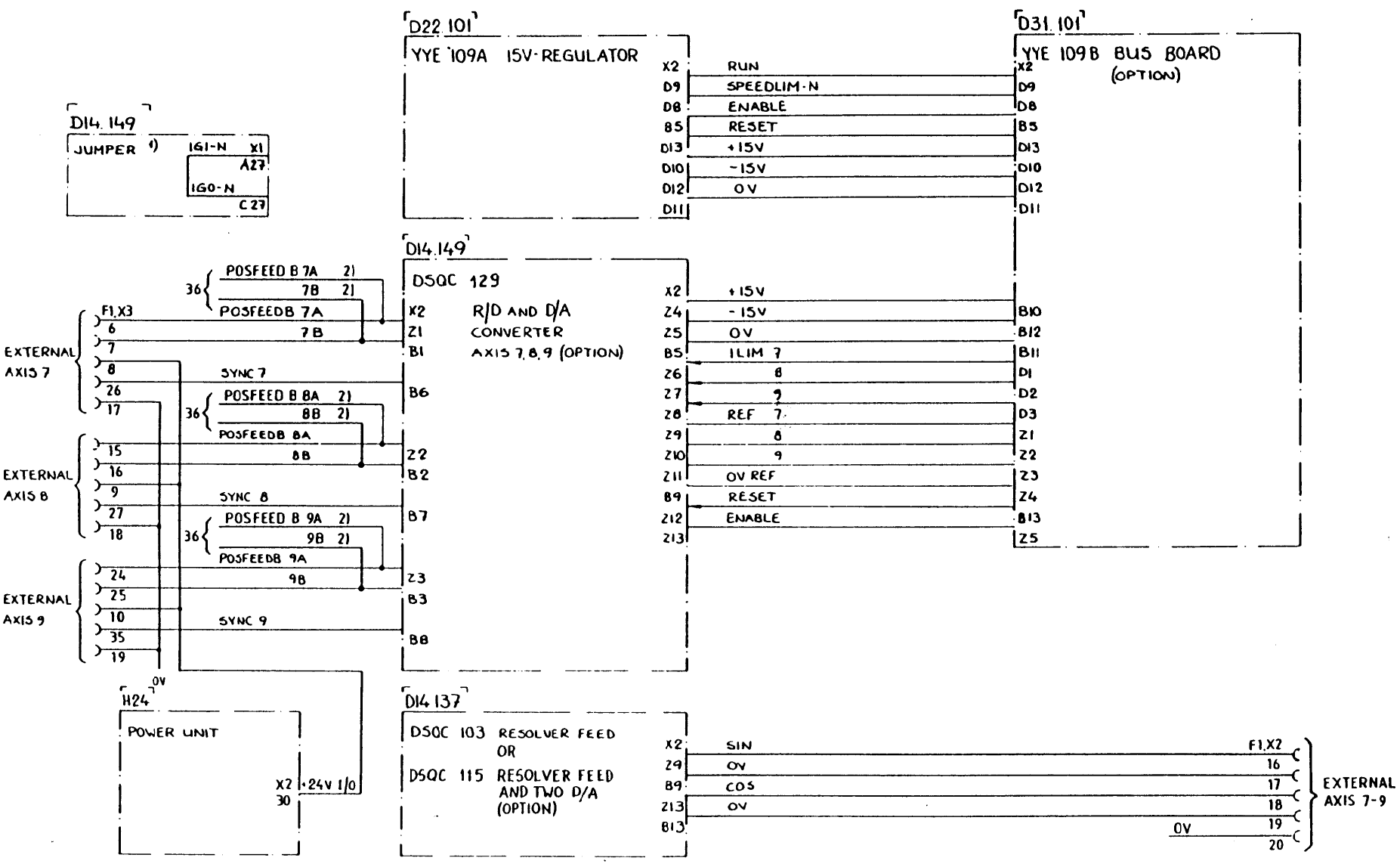
Asea Brown Boveri

Rev by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet: 21
SV | Cont: 22

6917 5339-AA (A3) Rev



1) ONLY IF R/D AND D/A CONVERTER AXIS 7,8,9 IS NOT USED

2) ONLY IF D14.3 IS MOUNTED (OPTION)

PRIMARY PART IN ARCADE

R/D AND D/A CONVERTER FOR AXIS 7,8,9 (OPTION)
RESOLVER FEED

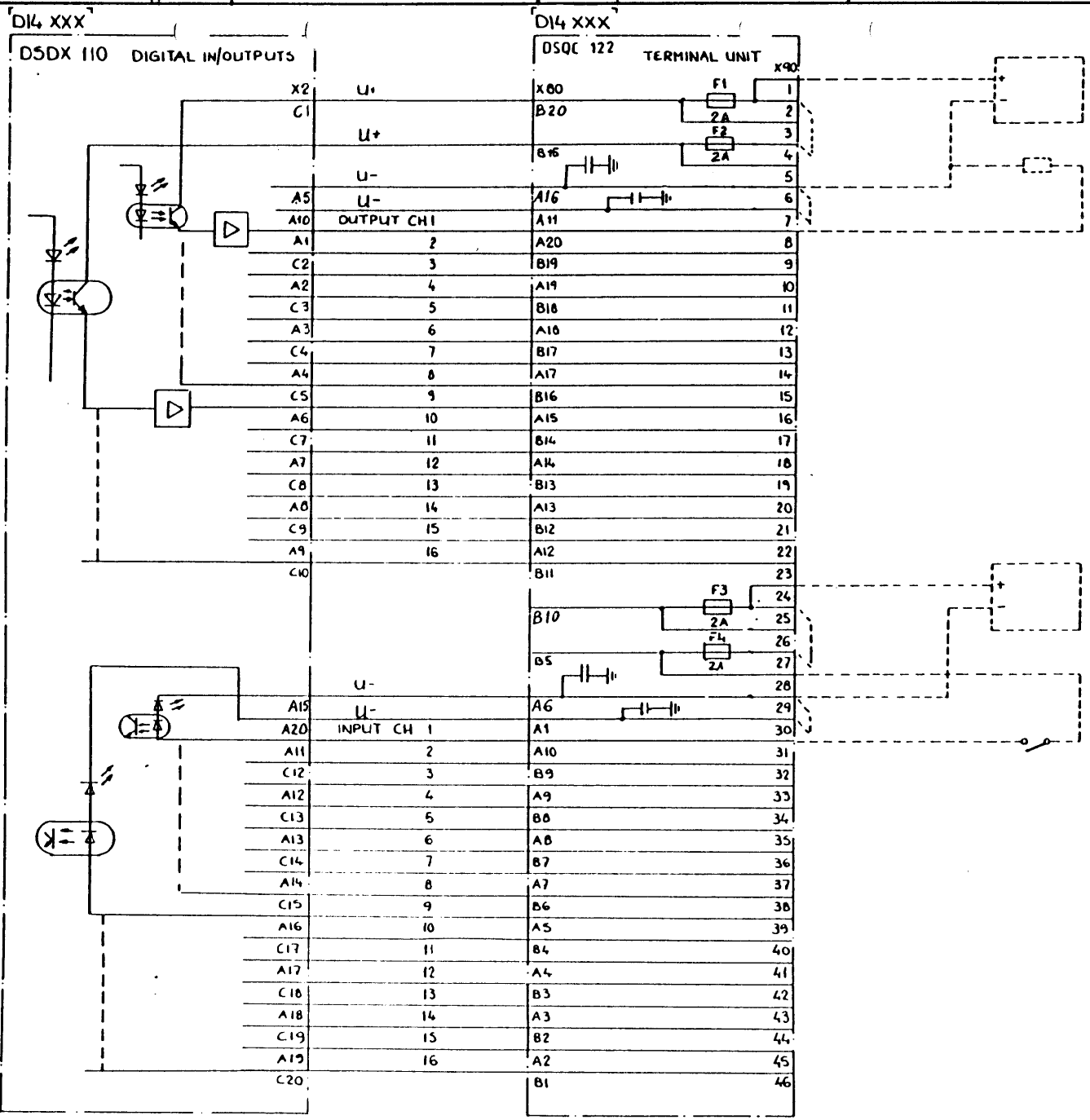
Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Ins by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind Sheet: SV 22
Cont: 23

6917 6339-AA (A3) Rev



ATTENTION!
THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

SIGNAL FUNCTIONS IF FIRST OPTIONAL BOARD	
CHANNEL	OUTPUT SIGNALS
1	RUN
2	CYCLE ON
3	ERROR
4	PROG UNIT EXTRACTED
5	GRIPP RELEASE 1
6	GRIPP RELEASE 2
7	SEARCH STOP
8	DIGITAL OUTPUT 7
⋮	⋮
16	DIGITAL OUTPUT 15
	INPUT SIGNALS
1	INTERRUPT INSTR
2	INTERRUPT PROGR
3	JUMP PROG 1
4	JUMP PROG 2
5	JUMP PROG 3
6	JUMP PROG 4
7	JUMP PROG 5
8	PROG START
9	PROG STOP
10	DIGITAL INPUT 8
⋮	⋮
16	DIGITAL INPUT 14

PRIMARY PART IN ARCADE

Drawn by | Order No. | TID-No | Design checked by | Rev Ind | Dept | Year Week | Sheet | Cont

Drawn by | Form No. | Design checked by | Rev Ind | Dept | Year Week | Sheet | Cont

Rev Ind | Revision | Appd | Year Week

DIGITAL IN/OUTPUTS 24V DC
DSDX 110 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

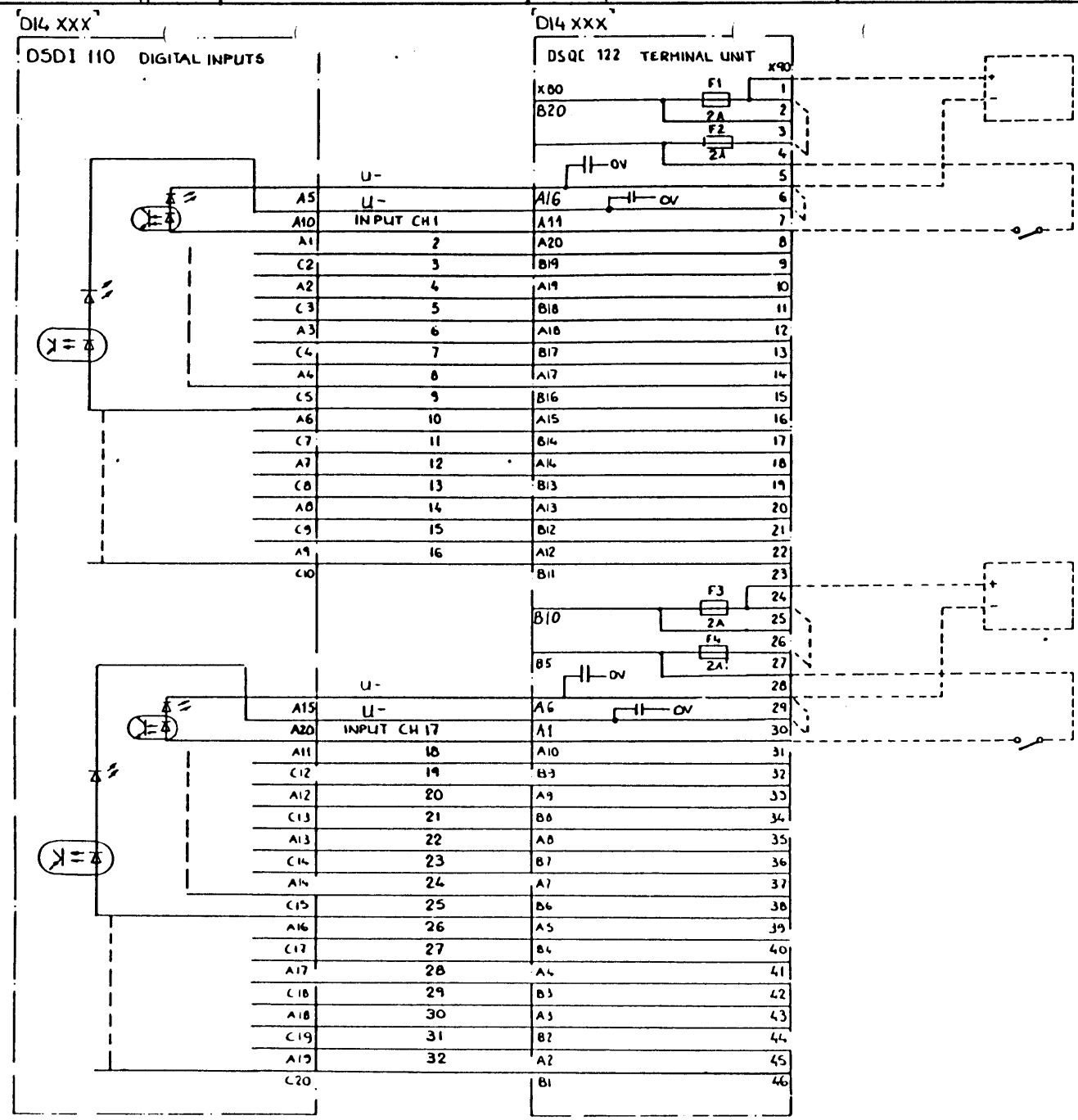
Asea Brown Boveri

Res by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet: 23
SV | Cont: 24

6917 5339 AA (A3) Rev



ATTENTION

THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

SIGNAL FUNCTIONS IF FIRST OPTIONAL INPUT BOARD	
CHANNEL	INPUT SIGNALS
1	INTERRUPT INSTR
2	INTERRUPT PROGR
3	JUMP PROG 1
4	JUMP PROG 2
5	JUMP PROG 3
6	JUMP PROG 4
7	JUMP PROG 5
8	PROG START
9	PROG STOPP
10	DIGITAL INPUT 8
⋮	⋮
32	DIGITAL INPUT 31

PRIMARY PART IN ARCADE

DIGITAL INPUTS 24V D.C.
DSDI 110 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

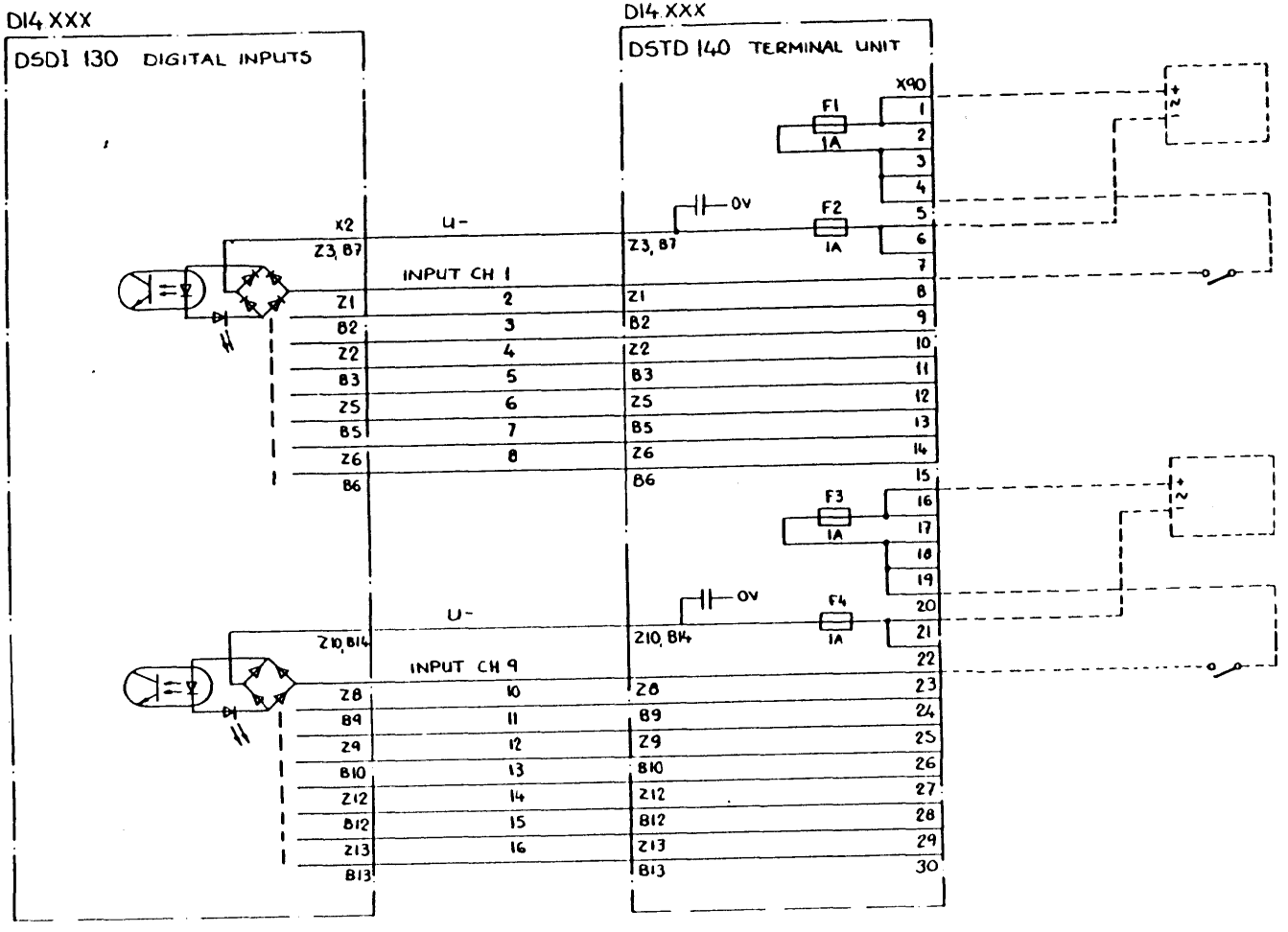
Asea Brown Boveri

Ins by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: SV
Sheet: 24
Cont: 25

6917 6339-AA (A3) Rev



ATTENTION!
THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION.

SIGNAL FUNCTIONS IF FIRST OPTIONAL INPUT BOARD	
CHANNEL	INPUT SIGNALS
1	INTERRUPT INSTR
2	INTERRUPT PROGR
3	JUMP PROG 1
4	JUMP PROG 2
5	JUMP PROG 3
6	JUMP PROG 4
7	JUMP PROG 5
8	PROG START
9	PROG STOP
10	DIGITAL INPUT 8
16	DIGITAL INPUT 14

PRIMARY PART IN ARCADE

DIGITAL INPUTS 110V A.C.
DSDI 130 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

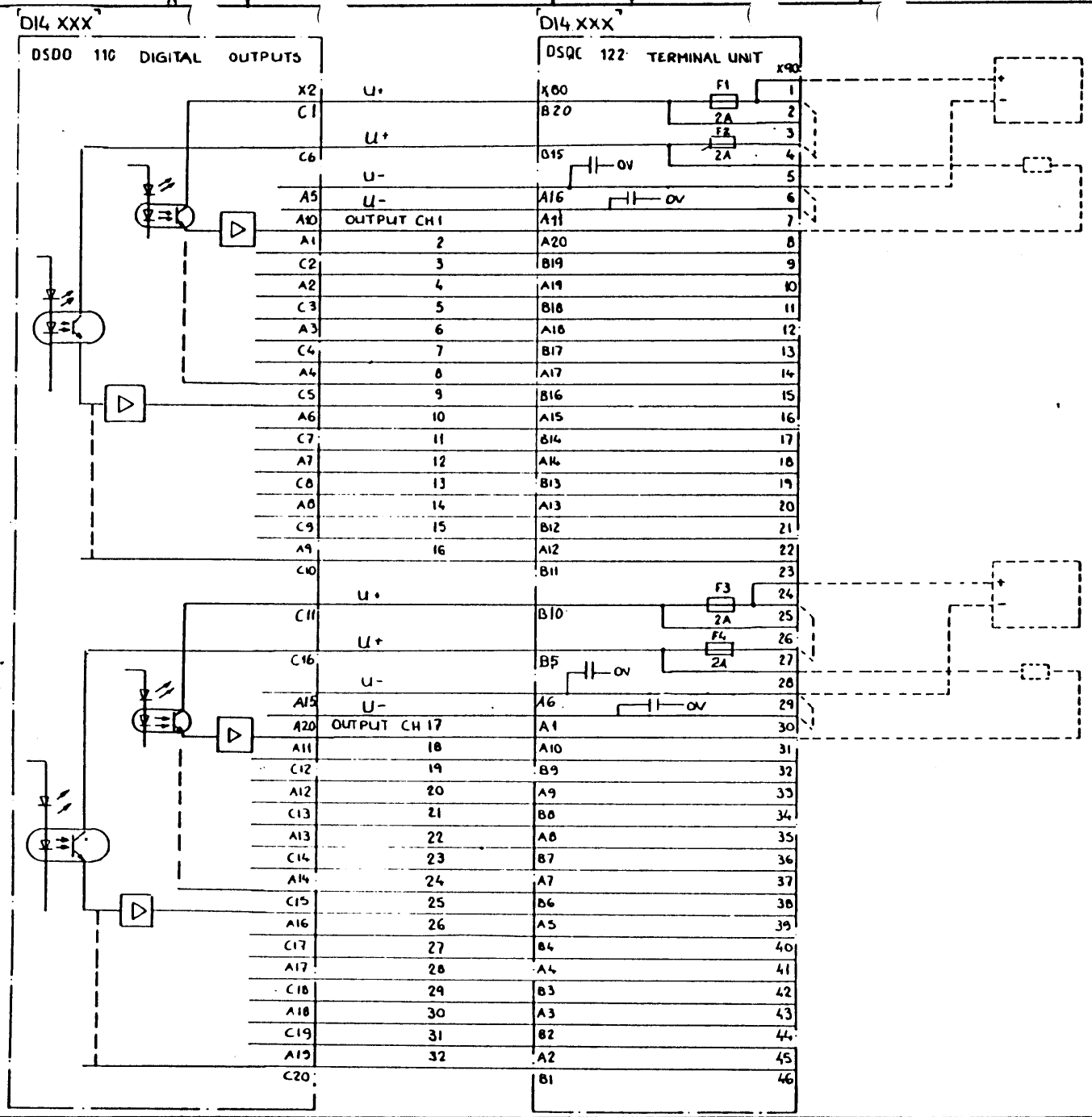
Iss by Dept' Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: SV
Sheet: 25
Cont: 26

Rev Ind | Revision | Appd | Year Week

5917 5339 AA (A3) Rev :::::



ATTENTION!
THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

SIGNAL FUNCTIONS IF FIRST OPTIONAL OUTPUT BOARD	
CHANNEL	OUTPUT SIGNALS
1	RUN
2	CYCLE ON
3	ERROR
4	PROGR UNIT EXTRACTED
5	GRIPP/RELEASE 1
6	GRIPP/RELEASE 2
7	SEARCH STOP
8	DIGITAL OUTPUT 7
⋮	⋮
32	DIGITAL OUTPUT 31

PRIMARY PART IN ARCADE

Drawn by | Order No. | Sheet | Cont
Design checked by | TID-No. | Year Week | Cont
Rev Ind | Dept | Rev Ind | Sheet

Drawn by | Form No. | Sheet | Cont
Design checked by | | Year Week | Cont
Rev Ind | Dept | Rev Ind | Sheet

Rev Ind	Revision	Appd	Year Week

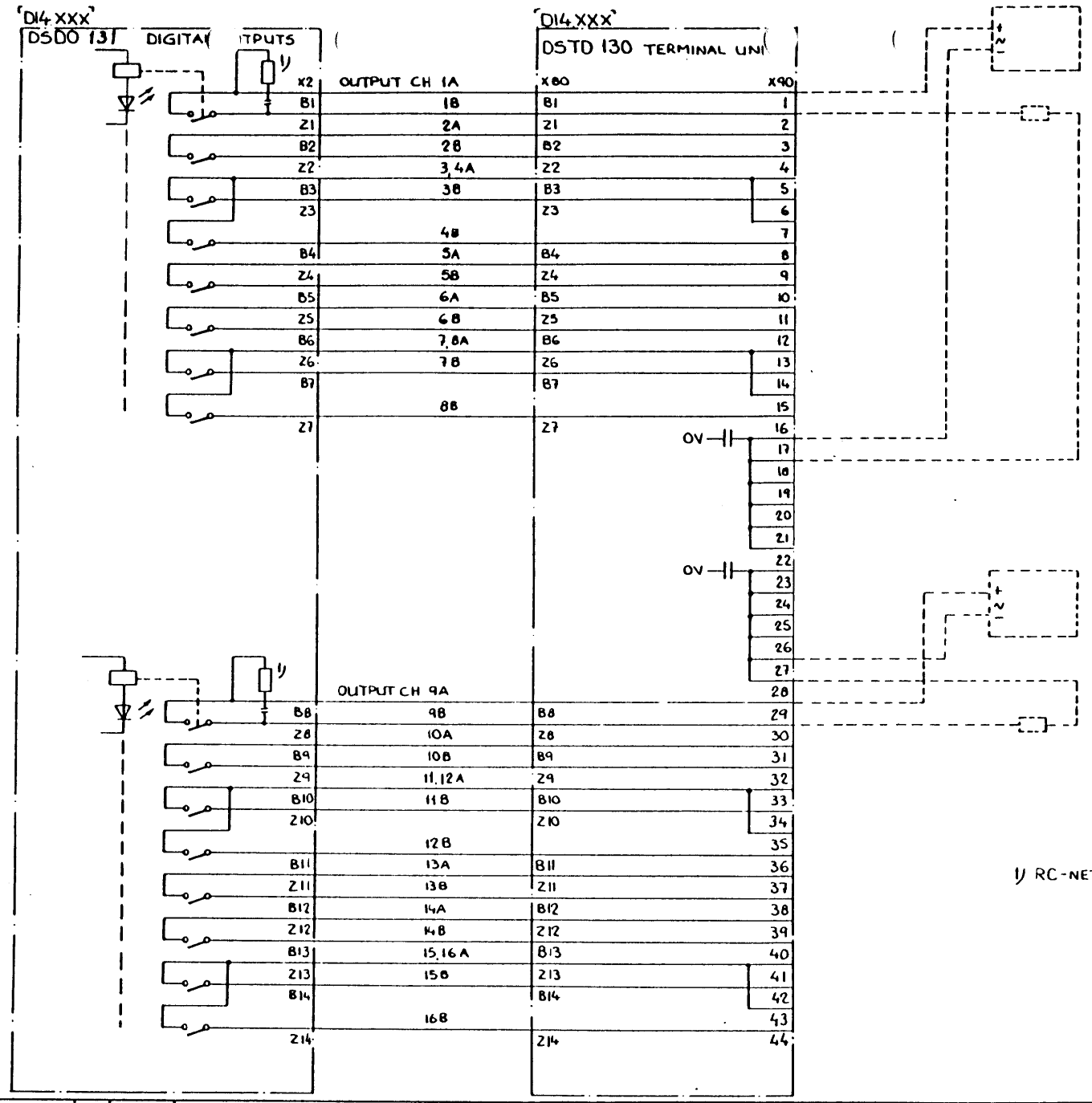
DIGITAL OUTPUTS 24V DC
DSDO 110 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Doc by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind | Sheet
SV | Cont 27



ATTENTION!
THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

SIGNAL FUNCTIONS IF FIRST OPTIONAL OUTPUT BOARD	
CHANNEL	OUTPUT SIGNALS
1	RUN
2	CYCLE ON
3	ERROR
4	PROGR UNIT EXTRACTED
5	GRIPP /RELEASE 1
6	GRIPP / RELEASE 2
7	SEARCH STOP
8	DIGITAL OUTPUT 7
⋮	⋮
16	DIGITAL OUTPUT 15

1) RC-NETWORK ACROSS EVERY OUTPUT

PRIMARY PART IN ARCADE

DIGITAL OUTPUTS RELAYS, 24-240V AC / DC
DSDO 131 (OPTION)

Design checked by: E HYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

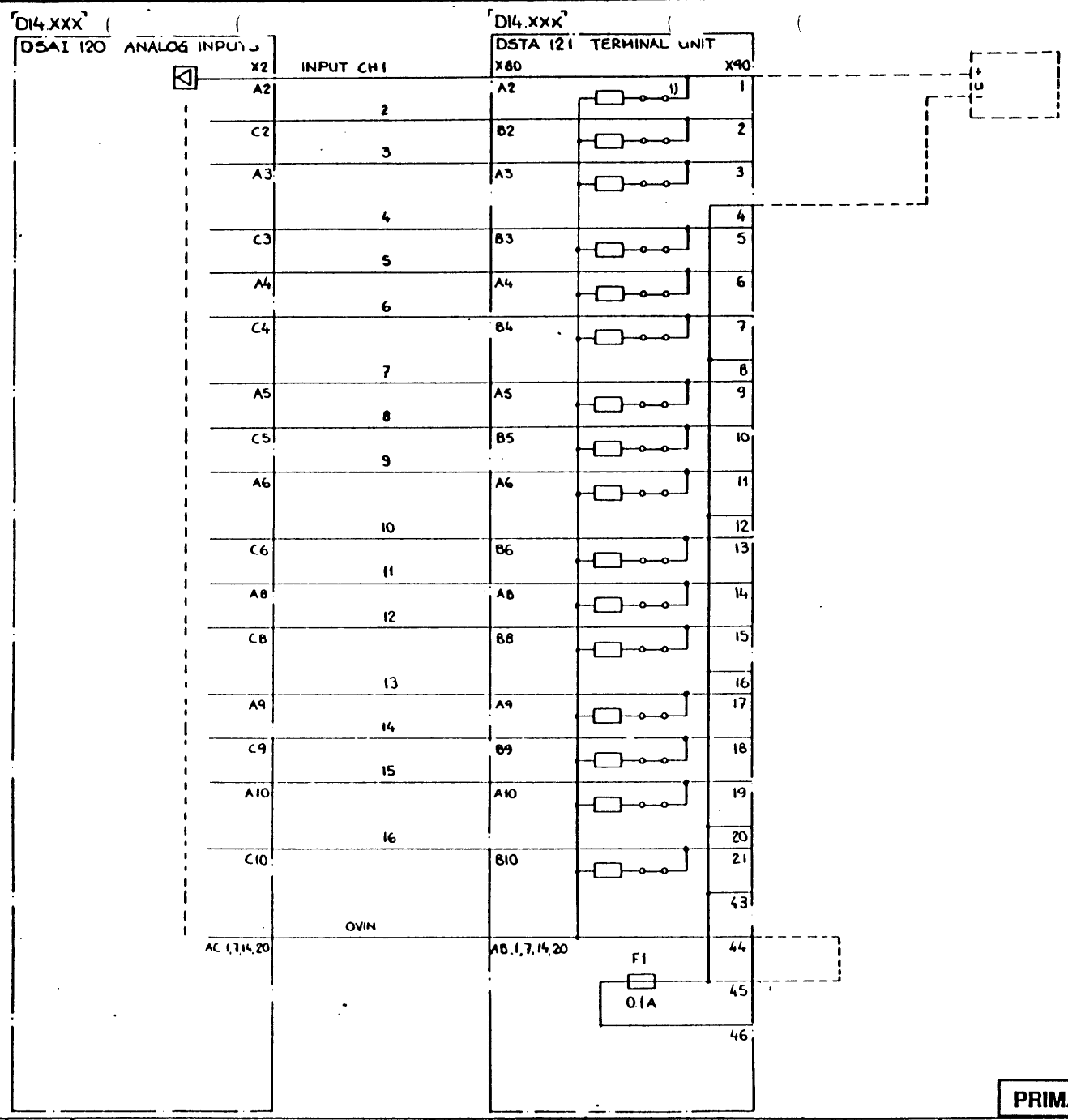
CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2
Asea Brown Boveri
Init by Dept Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: SV
Sheet: 27
Cont: 28

Rev Ind | Revision | Appd | Year Week

9817 5339-AA (A3) Rev



ATTENTION!

THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

1) OPEN STRAPS FOR VOLTAGE SIGNAL

PRIMARY PART IN ARCADE

ANALOG INPUTS 0-±10V
DSAI 120 (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Ins by Dept Year Week: ROB/BCS 89 37

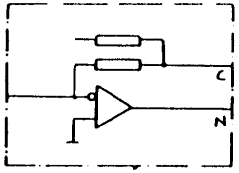
6704 600-ARA

Rev Ind: SV
Sheet: 28
Cont: 29

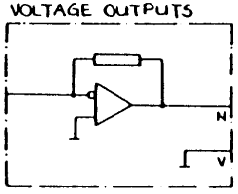
Rev Ind | Revision | Appd | Year Week

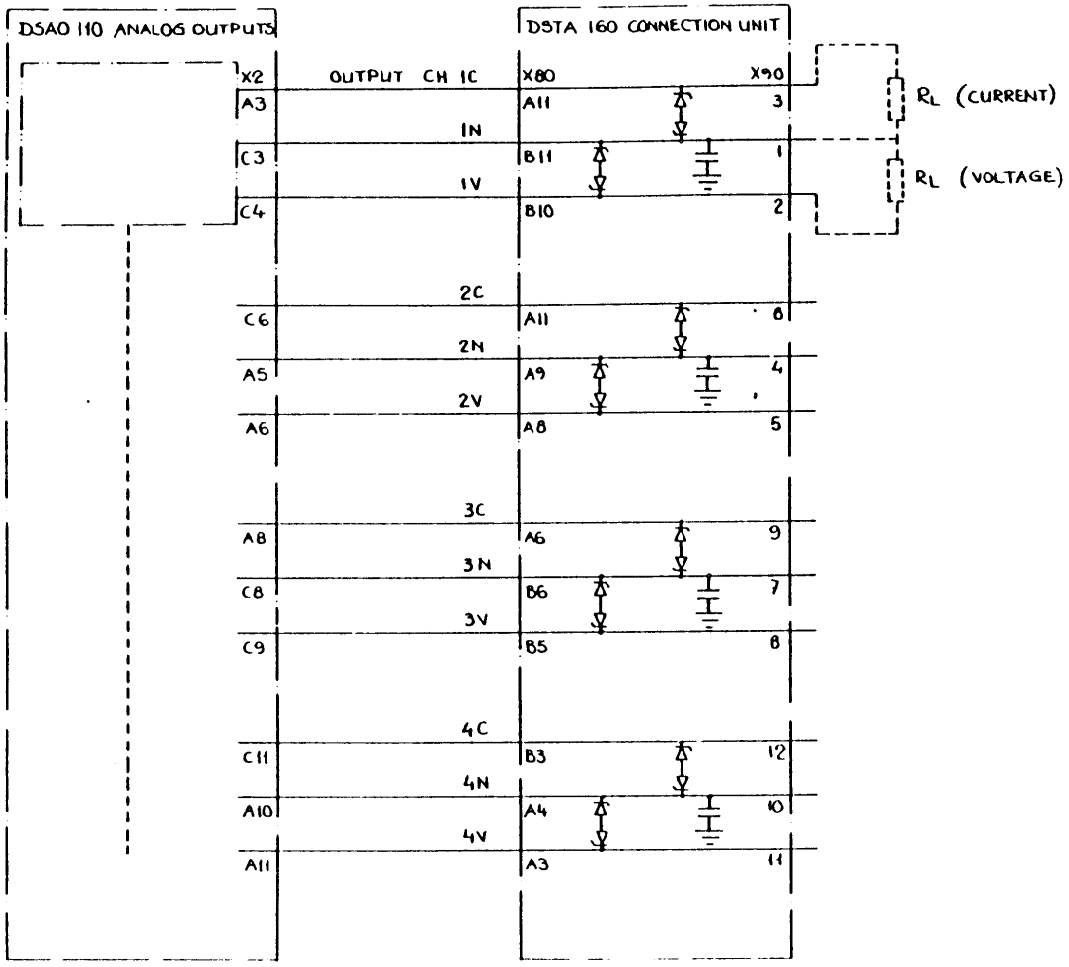
8917 5338-AA (A3) Rev :::::

CURRENT OUTPUTS



VOLTAGE OUTPUTS





ATTENTION!

THE BOARD IS PLACED ON POSITION ACCORDING TO THE ACTUAL SYSTEM CONFIGURATION

PRIMARY PART IN ARCADE

ANALOG OUTPUTS ±10V DSAO 110 (OPTION) ±10 mA ±20 mA	Design checked by: E MYKLEBUST Drawing checked by: C LINDSTRÖM Drawn by: LL/AK
CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2	Asea Brown Boveri Ins by Dept' Year Week: ROB/BCS 89 37
6704 600-ARA	Rev Ind: SV Sheet: 29 Cont: 29.5

8817 5338-AA (A3) Rev

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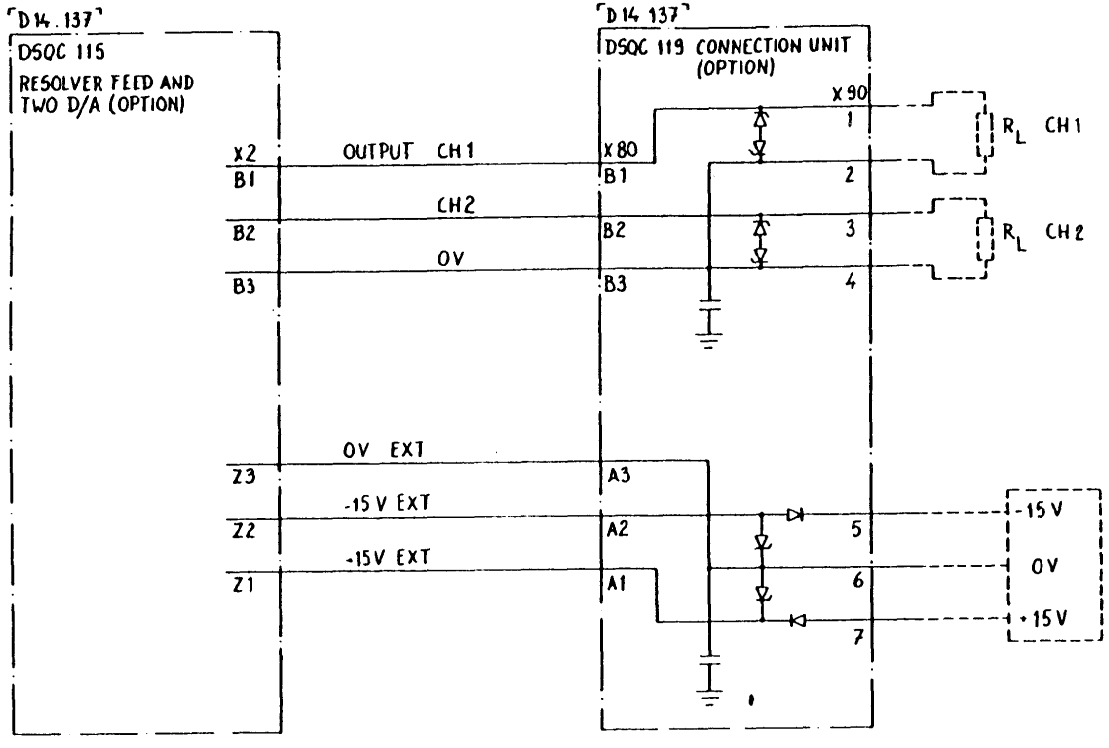


PRIMARY PART IN ARCADE

ANALOG OUTPUTS ±10V
(OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Rev by Dept Year Week: ROB/BCS 89 37

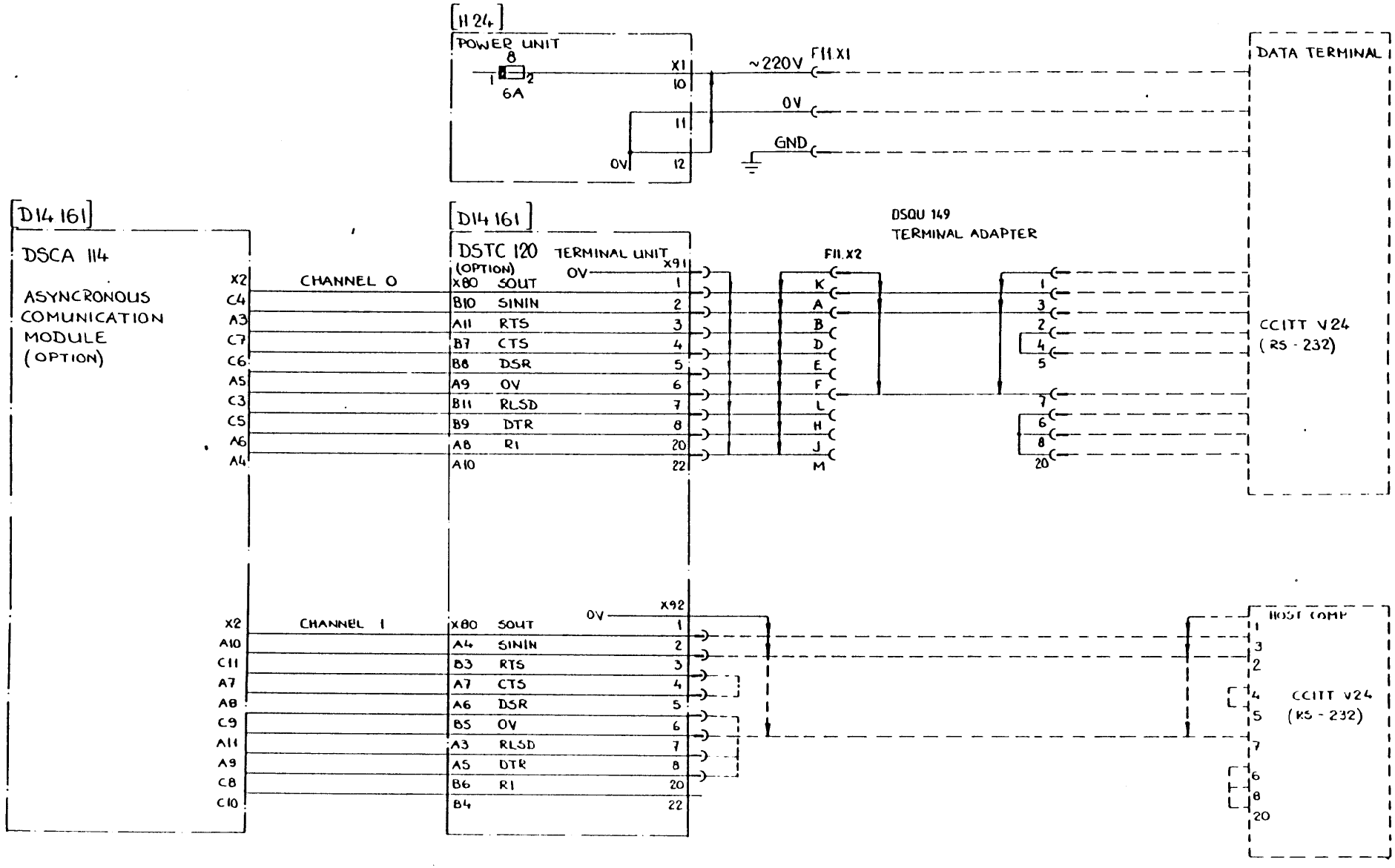
6704 600-ARA

Rev Ind | Sheet: 29,5
Sheet | Cont: 30

Rev Ind | Revision | Appd | Year | Week

6917 5339-AA (A3) Rev

Drawn by | Form No | Design checked by | Rev Ind | Dept | Year Week | Sheet | Cont



PRIMARY PART IN ARCADE

DATA TERMINAL AND COMPUTER LINK CONNECTION (OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Res by Dept' Year Week: ROB/BCS 89 37

6704 600-ARA

Rev Ind: Sheet
Rev Ind: Sheet: 30
SV: Cont: 31

Rev Ind | Revision | Appd | Year Week

6917 5339-AA (A3) Rev

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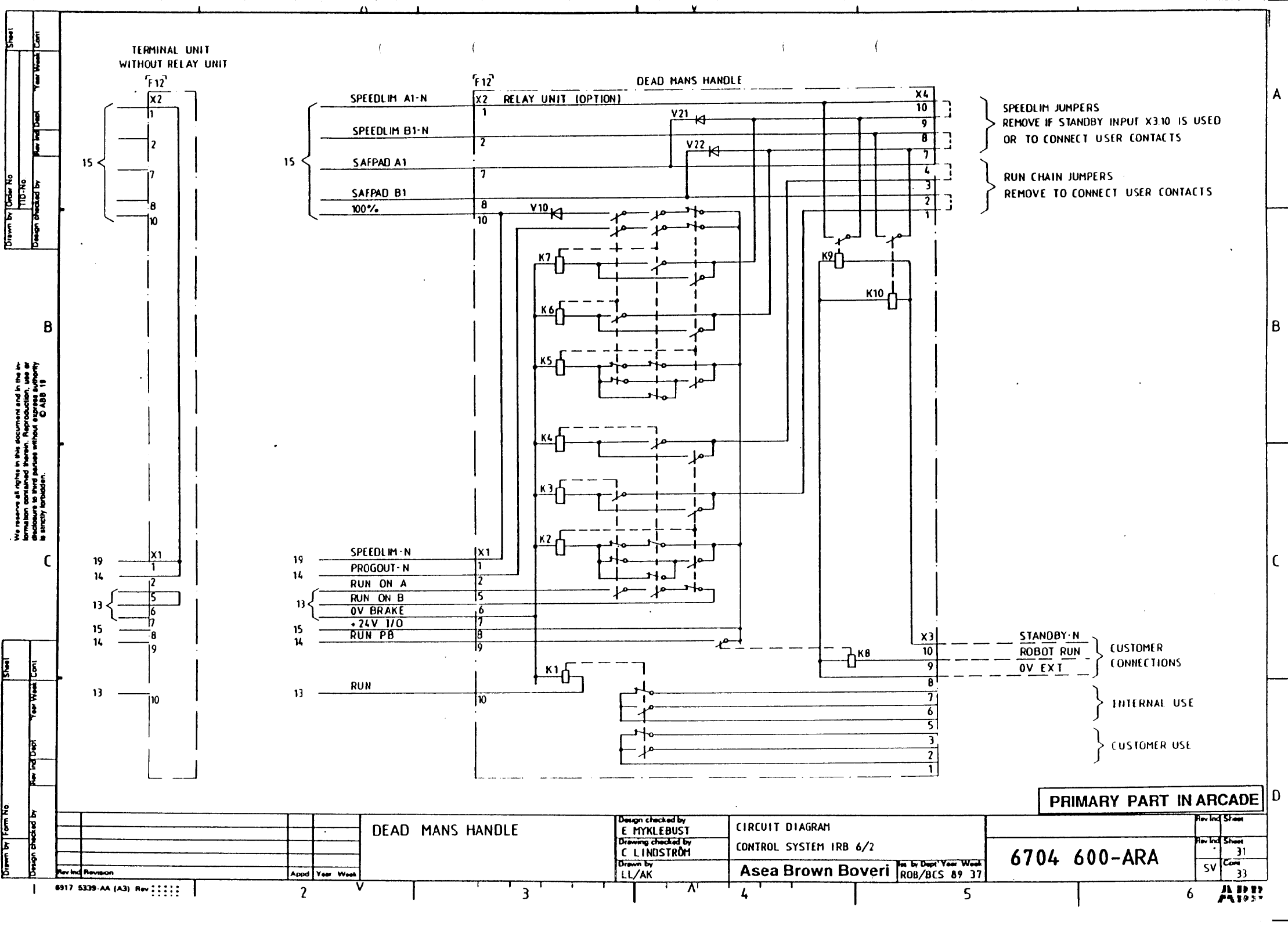
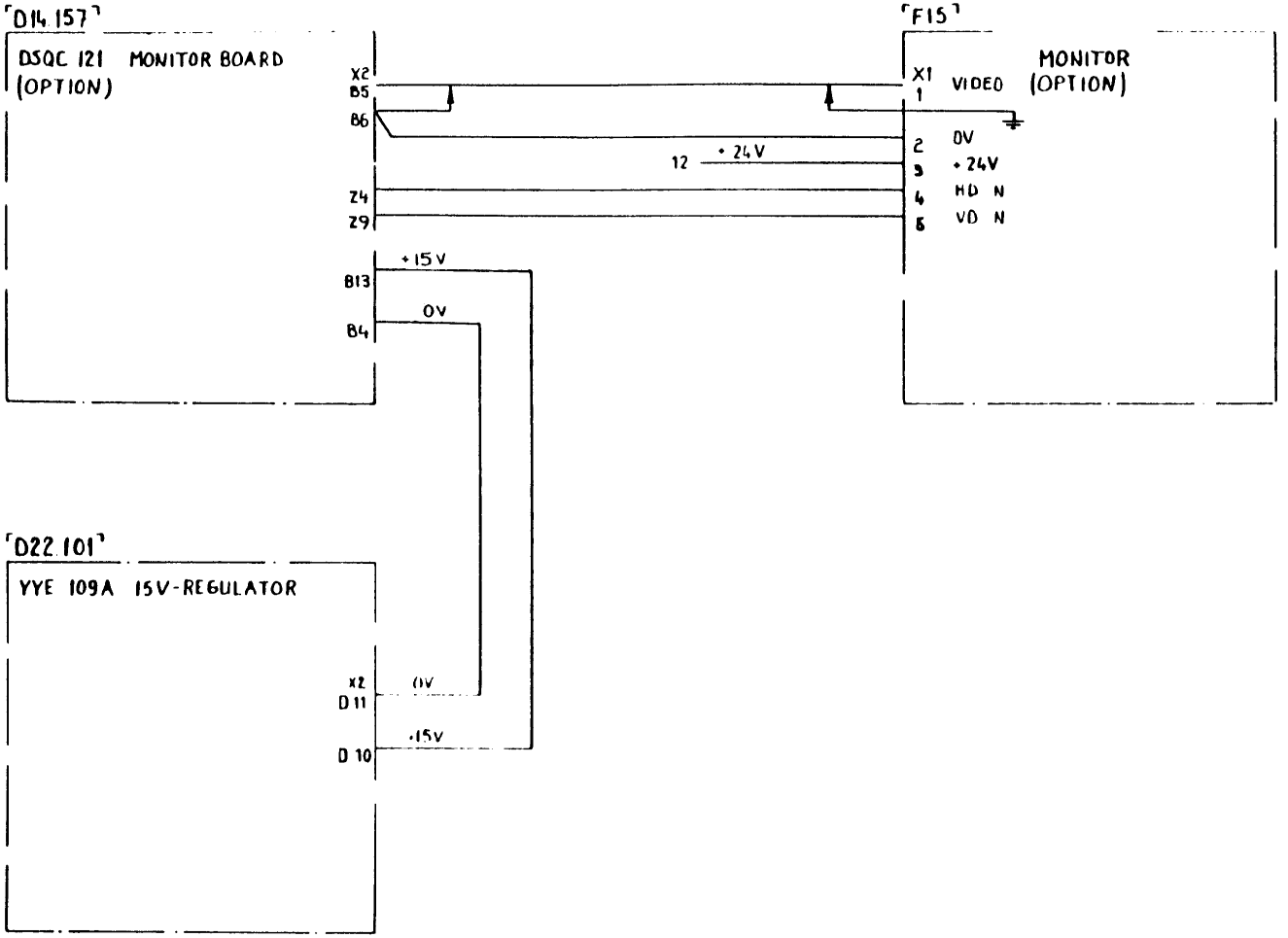


PRIMARY PART IN ARCADE

Rev Ind	Revision	Appd	Year Week	DEAD MANS HANDLE	Design checked by E MYKLEBUST	CIRCUIT DIAGRAM		Rev Ind	Sheet
					Drawing checked by C LINDSTRÖM	CONTROL SYSTEM IRB 6/2	6704 600-ARA	Rev Ind	Sheet 31
					Drawn by LL/AK	Asea Brown Boveri ROB/BCS 89 37		SV	Cont 33

8917 5339-AA (A3) Rev



PRIMARY PART IN ARCADE

PROGRAM DISPLAY
(OPTION)

Design checked by: E MYKLEBUST
Drawing checked by: C LINDSTRÖM
Drawn by: LL/AK

CIRCUIT DIAGRAM
CONTROL SYSTEM IRB 6/2

Asea Brown Boveri

Rev by Dept Year Week: ROB/BCS 89 37

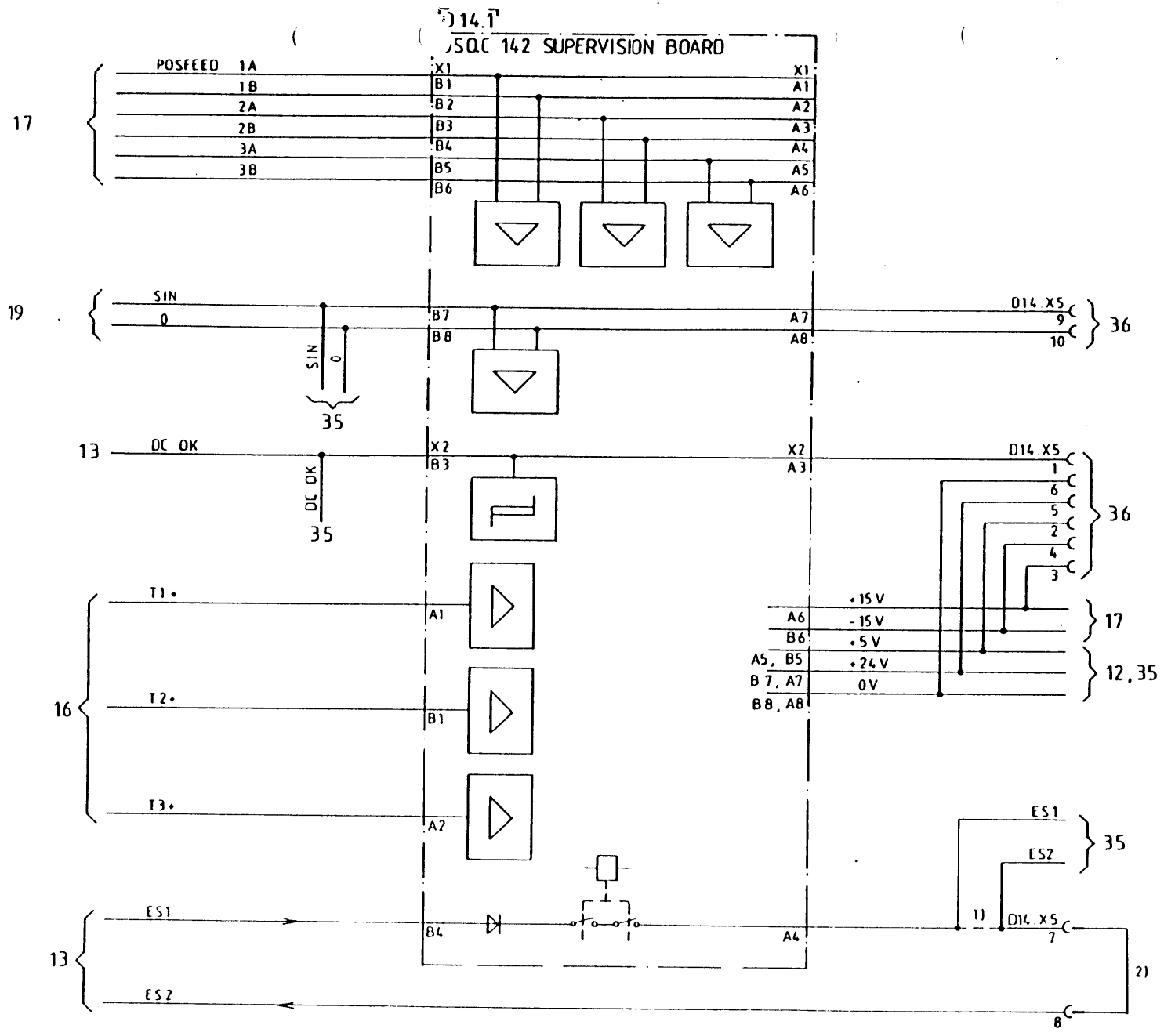
6704 600-ARA

Rev Ind: Sheet: 33
Rev Ind: SV Cont: 34

Rev Ind | Revision | Appd | Year Week

8917 5238-AA (A3) Rev

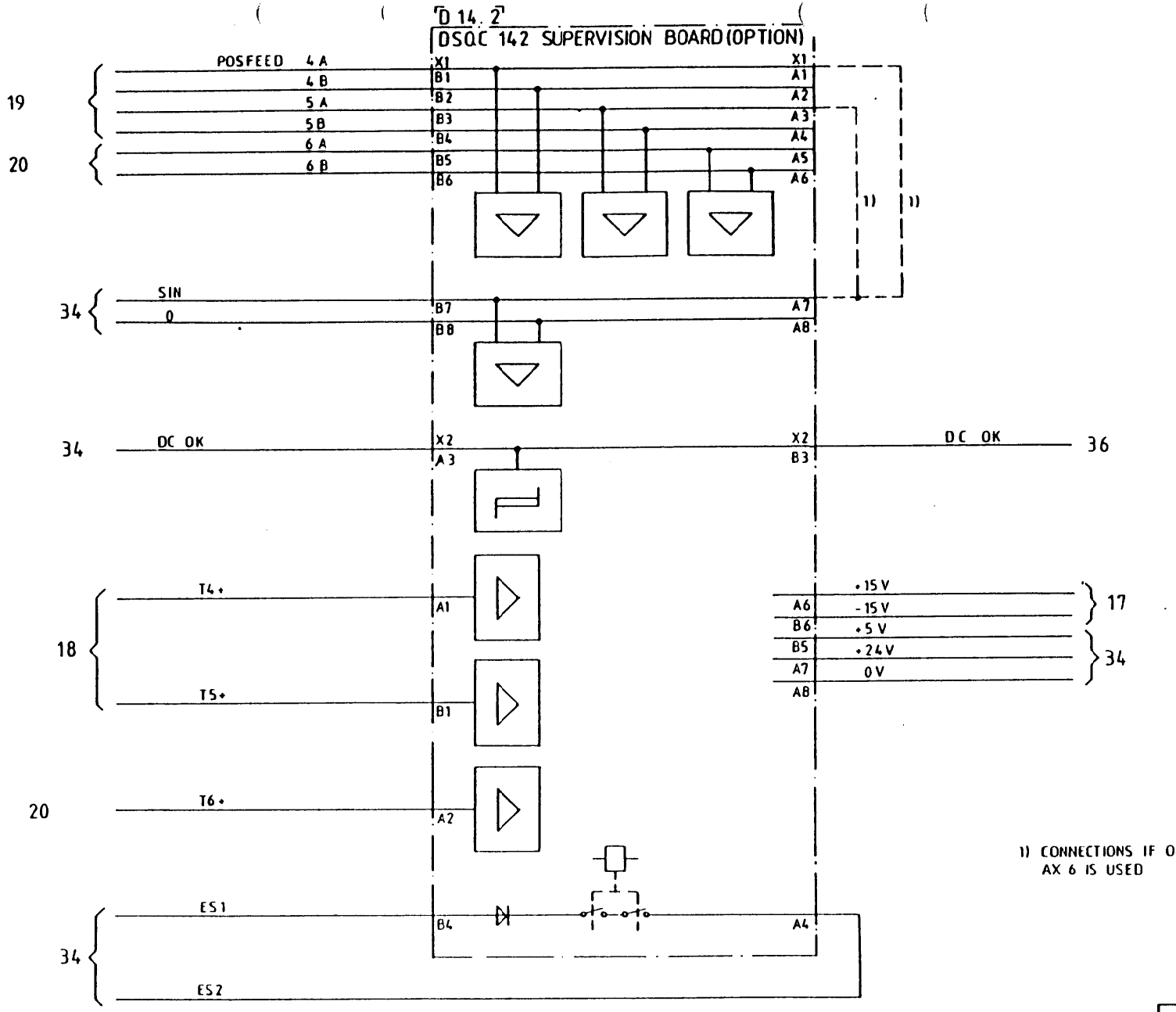
ABB



PRIMARY PART IN ARCADE

SUPERVISION BOARD AXES 1-3	Design checked by E MYKLEBUST; Drawing checked by C LINDSTRÖM; Drawn by LL/AK	CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2	6704 600-ARA
Rev Ind Revision; Appd; Year Week		Asea Brown Boveri; Issued by Dept Year Week ROB/BCS 89 37	Rev Ind Sheet 34; SV Cont 35

8917 5339-AA (A3) Rev



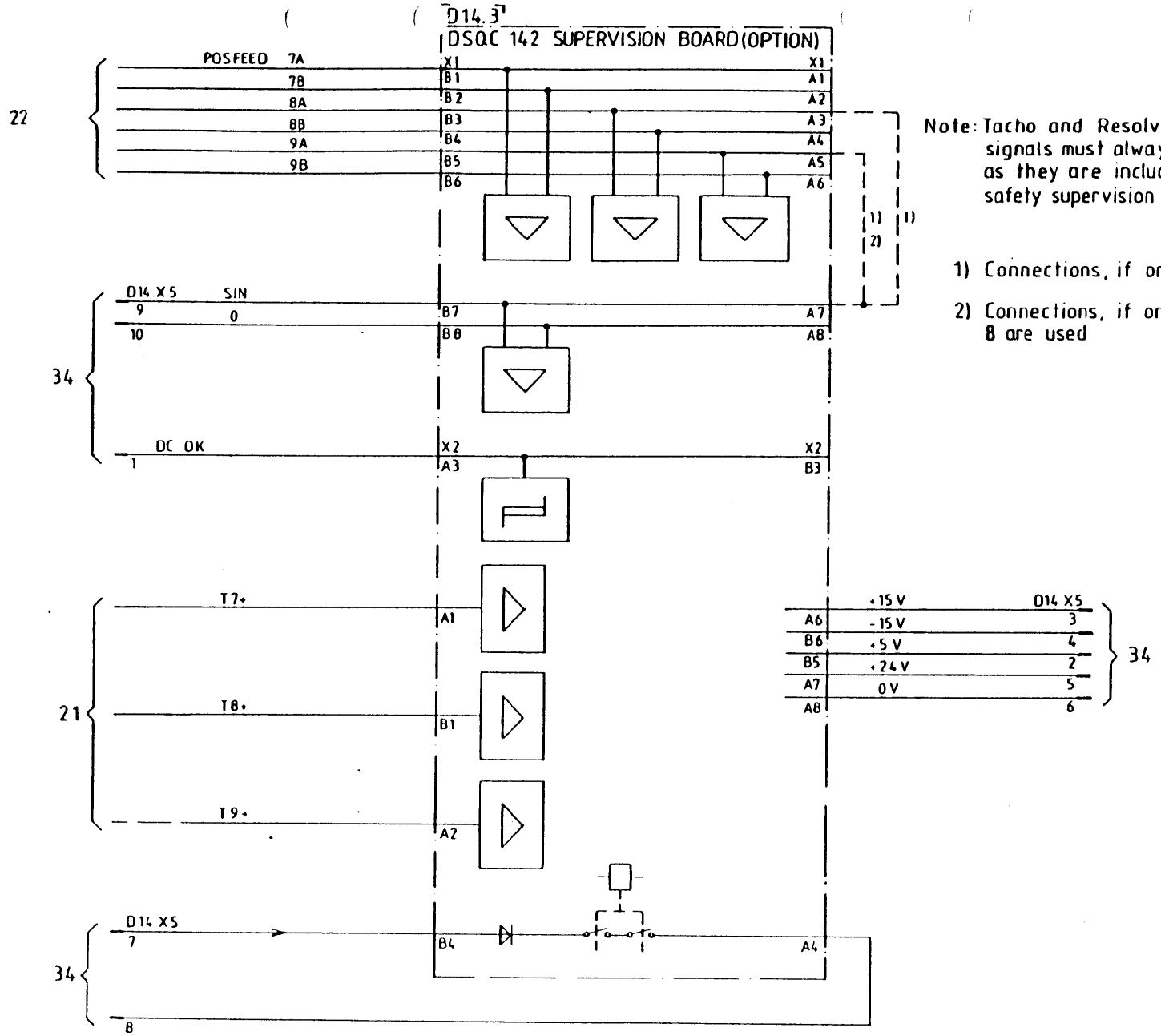
PRIMARY PART IN ARCADE

Rev Ind	Revision	Appd	Year Week	SUPERVISION BOARD AXES 4-6 (OPTION)	Design checked by: E MYKLEBUST; Drawing checked by: C LINDSTRÖM; Drawn by: LL/AK	CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2 Asea Brown Boveri	6704 600-ARA

Rev Ind: Sheet 35; SV: Cont 36

6917 5339-AA (A3) Rev

ABB



PRIMARY PART IN ARCADE

Rev Ind	Revision	Acpd	Year Week	SUPERVISION BOARD AXES 7-9 (OPTION)	Design checked by E MYKLEBUST; Drawing checked by C LINDSTRÖM; Drawn by LL/AK	CIRCUIT DIAGRAM CONTROL SYSTEM IRB 6/2 Asea Brown Boveri	6704 600-ARA

Res by Dept Year Week ROB/BCS 89 37

Rev Ind Sheet: SV

Sheet: 36

Cont: —

6917 5339-AA (A3) Rev