Control Technology
Mechatronics
## Contents

**CONTROL TECHNOLOGY**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL TECHNIQUES BASIC COURSE - PLC</td>
<td>2</td>
</tr>
<tr>
<td>AUT 302000 PLC Module for Base Unit 2000</td>
<td>3</td>
</tr>
<tr>
<td>AUT 310712 Programming Software for PC</td>
<td>3</td>
</tr>
<tr>
<td>AUT 310145 SC-09 Signal Cable</td>
<td>3</td>
</tr>
<tr>
<td>AUT 310070 FX-10P-E Programming Unit for the PLC</td>
<td>3</td>
</tr>
<tr>
<td>AUT 310160 Cable for Hand Programming Unit</td>
<td>3</td>
</tr>
<tr>
<td>AUT 302001 Simulation Module</td>
<td>4</td>
</tr>
<tr>
<td>AUT 302002 Traffic Module</td>
<td>4</td>
</tr>
<tr>
<td>AUT 302003 Cylinder Module</td>
<td>4</td>
</tr>
<tr>
<td>AUT 302004 Terminal Block Module</td>
<td>4</td>
</tr>
<tr>
<td>AUT 302005 Ball Selector</td>
<td>5</td>
</tr>
<tr>
<td>AUT 302006 Logic Module</td>
<td>5</td>
</tr>
<tr>
<td>ELE 102000 Base Unit 2000</td>
<td>5</td>
</tr>
</tbody>
</table>

**BASIC TECHNIQUES IN PNEUMATICS AND CONTROL - PLC**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU 5900 Mecha-Kit</td>
<td>6</td>
</tr>
<tr>
<td>ELE 102000 Base Unit 2000</td>
<td>8</td>
</tr>
<tr>
<td>AUT 302000 PLC Module for Base Unit 2000</td>
<td>8</td>
</tr>
<tr>
<td>AUT 310712 Programming Software for PC with AUT 310 145 SC-09 Signal cable</td>
<td>8</td>
</tr>
<tr>
<td>AUT 310070 Hand-Programming Unit with AUT 310160 Signal Cable</td>
<td>8</td>
</tr>
<tr>
<td>AUT 302001 Simulation Module</td>
<td>9</td>
</tr>
<tr>
<td>AUT 302004 Terminal Block Module</td>
<td>9</td>
</tr>
<tr>
<td>AUT 302002 Traffic Lights Module</td>
<td>9</td>
</tr>
<tr>
<td>Lists of components in Mecha-Kit</td>
<td>11</td>
</tr>
<tr>
<td>MT 0415 Compressor</td>
<td>12</td>
</tr>
</tbody>
</table>

**ADVANCED PNEUMATICS AND CONTROL TECHNIQUES - PLC**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The YO-YO Factory</td>
<td>13</td>
</tr>
<tr>
<td>AU 5510 Magazine Module</td>
<td>14</td>
</tr>
<tr>
<td>AU 5520 Drilling Module</td>
<td>14</td>
</tr>
<tr>
<td>AU 5530 Selection Module</td>
<td>15</td>
</tr>
<tr>
<td>AU 5540 Assembly Module</td>
<td>15</td>
</tr>
<tr>
<td>AU 5550 Quality Control Module</td>
<td>16</td>
</tr>
<tr>
<td>AU 5591 I/O Module</td>
<td>16</td>
</tr>
<tr>
<td>AU 5592 Control Panel</td>
<td>16</td>
</tr>
<tr>
<td>MT 1225 Compressor</td>
<td>17</td>
</tr>
<tr>
<td>AU 5595 SCADA Module</td>
<td>18</td>
</tr>
<tr>
<td>Mode of Operation</td>
<td>19</td>
</tr>
<tr>
<td>Profibus / SCADA</td>
<td>19</td>
</tr>
</tbody>
</table>

**ADDITIONAL CONTROL OBJECTS**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUT 300050 Automatic Laundry Model</td>
<td>20</td>
</tr>
<tr>
<td>AUT 300080 Lift Model</td>
<td>20</td>
</tr>
</tbody>
</table>

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CONTROL TECHNIQUES BASIC COURSE - PLC

The Basic Control Technology course offers a good ground training before more advanced courses in control technology and automation. The courses in this concept make use of a Laboratory Exercise Book.

The laboratory package includes:
- Logic Module
- Ball Selection Module
- Terminal Block Module
- Software GX-Developer
- Simulation Module
- Traffic Lights Module
- PLC Module
- Cylinder Module

The logic module for the Base Unit 2000 contains a logic block with switch and light diodes and various other relays. The Melsec PLC board has 8 inputs and 6 outputs. Inputs and outputs of the PLC are connected to a 20 pin socket. A hand programming unit is connected to the PLC for programming. Alternatively the PLC software GX developer can be used. The simplest PLC practices can be performed using a simulator board which shows the input status in the form of 6 LED’s and has output signals simulated by 8 on/off switches. With the traffic lights module, pedestrian and vehicle control can be programmed. The cylinder module introduces pneumatics and sensors. The ball selection module gives more training with pneumatics. Balls of metal and non-metal are taken from a storage area and sent to a selection station where the balls are detected by an optical sensor.

Technical Literature:
BOK320030 Introduction to PLC, Laboratory Exercises
BOK312002 Basic PLC, Laboratory Exercises
**AUT 302000 PLC Module**

The PLC Module is to be mounted on the Base Unit 2000. To program the PLC, a programming unit is used connected to a programming port. Alternatively, PC software may be used for programming.

The PLC Module contains a PLC-system with sockets to connect to the module card, selected. There are several switches connected to the sockets to simulate faults at the different in- and outputs.

**General Data:**
- Melsec PLC (24V)
- 8 inputs and 6 outputs
- Input and output of the PLC is connected to a 20 pin socket
- Dimension: 240 x 140 x 30 mm
- Weight: 0.5 kg

**AUT 310712 Programming Software for PC with AUT 310145 SC-09 Signal Cable**

Programming software GX-Developer for programming of PLC from the PC, with cable (see page 5) suitable for connection between the PC and PLC.

**General Data:**
- Dimension: 160 x 85 x 30 mm
- Weight: 0.3 kg

**AUT 310145 SC-09 Signal Cable**

A signal cable is required to transfer the input signals.

**General Data:**
- This interface cable is connected between the PC and the PLC for transfer of programmes.
- Length: 1.5 m
- Weight: 1 kg

**Alternative:**

**AUT 310070 Hand-Programming Unit with AUT 310160 Cable**

Hand-Programming Unit for programming the Melsec PLC system, and cable having connectors suitable for connection between the Hand-Programming Unit and the PLC.

**General Data:**
- Dimension: 180 x 85 x 25 mm
- Weight: 0.3 kg
AUT 302001 Simulation Module
The input signal levels can be altered using the simulation module that is plugged into the sockets of the PLC Module
General Data:
Shows output status with 6 LED’s and has input signals simulated by 8 on/off switches.
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg

AUT 302002 Traffic Lights Module
The Traffic Lights Module is to be connected to the PLC Module. The Module simulates a traffic crossing for cars and pedestrians at a pedestrian crossing. When experimenting with the Traffic Module, the student has the task of creating a PLC program to control the traffic lights.
General Data:
There are red and green lights for the pedestrian crossing and red, amber and green for the vehicle traffic.
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg

AUT 302003 Cylinder Module
This module is used to study the actions and uses of electrically controlled valves.
General Data:
The module consists of two pneumatic cylinders, two electrically controlled valves and four sensors. The components are mounted on a metal panel. Compressed air (3-8bar) is required.
Dimension: 200 x 140 x 90 mm
Weight: 1 kg

AUT 302004 Terminal Block Module
The Terminal Block Module is to be connected to the PLC-Module. The PLC-Module together with the the Terminal Block Module will be used for connections to the Ball Selection Module. The connections will be made with one wire to each output and input. In this case there will be 8 inputs and 6 outputs for control of the valves (for the cylinders), and sensors on the Ball Selection Module.
General Data:
Connection between PLC and Lab Equipment
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg
AUT 302005 Ball Selection Module

This module is used to select balls of different colour and material to two different stores. It includes store, collect position having a measurement fixture, two outputs positions and two stores.

General Data:
On the board there is magnetic detection, inductive sensor and micro switch. The Ball Selection Module gives the student more advanced training in pneumatics. From a storage area, the balls of metal and non-metallic materials are sent down to a sorting station.
The arrival of the balls is detected by an optical sensor. The selection is made by a shuttle cylinder that carries the balls to the relevant container. A mini cylinder deposits the balls into the correct container. The Ball Selection Module is connected to the PLC board via the Terminal Block Module.

Dimension: 340 x 360 x 240 mm
Weight: 5.5 kg

AUT 302006 Logic Module

The Logic Module is built up from one, and two pole switches that can be normally open or normally closed.

General Data:
This module has two 20 pin connectors for connecting external modules. e.g. Simulation Module, Traffic Lights Module, Cylinder Module or Terminal Block Module.

Dimension: 240 x 140 x 30 mm
Weight: 0.3 kg

ELE 102000 Base Unit 2000

The starting point of this laboratory system is Base Unit 2000, a control panel and PCB-holder.
The Base Unit can be loaded with laboratory cards which have been carefully designed to suit each particular area of study. The Lab Cards are placed in slots and are automatically powered via a D-sub connector.

General Data:
Supply voltage 220-240V 50-60Hz 1-phase.
The unit has 6 outputs with following data:
Outputs 1-3: DC 12V / 3A with LED indication and fuse.
Outputs 4-6: AC 24V / 3A with LED indication and fuse.

Dimension: 370 x 180 x 75 mm.
Weight: 4 kg
Other supply voltages available on request.
AU 5900 Mecha-Kit

Terco Mecha-Kit is a modular system for basic education in pneumatic and control techniques, known today as Mechatronics.

The Kit consists of an aluminium base plate and a hard case, and a plastic box containing a number of different components within the field of Mechanics, Electronics, and Pneumatics.

With the Kit the students can build a number of simple automatically controlled handling units where only the imagination of the students sets the limit.

All electrical wiring and pneumatic circuitry work is done by the students.

The combination of direct hands on training and almost unlimited possibilities, inspire the students and quickly increases their interest in this kind of engineering.

Most of the handling units can be linked to a PLC unit for automated control.

The units can be linked together and form a network and simulate a flexible manufacturing cell.

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The Mecha-Kit System

Mecha-Kit components are contained in a hard shell hand box which is easy to carry and to stowe away.
Lists of the components in the Mecha-Kit are specified on pages 11-12.
The exercises are completed using the Mecha-Kit. The kit includes various pneumatic components to be assembled in automation exercises. An automated installation is often made up of various mechanical units capable of performing specific tasks with a high degree of efficiency. Units with linear, swivel or rotary movements are easily constructed using profile systems. One of the advantages of a profile system is the relative ease with which portals can be built up for the inclusion of linear movement. Stands, frames or portals for automation units are built using combinations of three different units:

**General Data:**
- Operating Voltage 24V DC +/- 10%
- Working Pressure 5-7 bars
- Dimension: 600 x 590 x 220 mm
- Weight: 17.5 kg

Manometers and components of industrial standards are used.
An assembled portal robot, 2 axis.
ELE 102000 Base Unit 2000

The starting point of this laboratory system is Base Unit 2000, a control box and PCB-holder. The Base Unit can be loaded with laboratory cards which have been carefully designed to suit each particular area of study. The Lab Cards are placed in slots and are automatically powered via a D-sub connector.

General Data:
Supply voltage: 220-240V 50-60Hz 1-phase.
The unit has 6 outputs with following data:
Output 1-3: DC 12V / 3A with LED indication and fuse.
Output 4-6: AC 24V / 3A with LED indication and fuse.
Dimension: 370 x 180 x 75 mm.
Weight: 4 kg

Other supply voltages available on request.

AUT 302000 PLC Module for Base Unit 2000

The PLC Module is to be mounted on the Base Unit 2000. To program the PLC, a programming unit is used connected to a programming port. Alternatively PC software may be used for programming. The PLC Module contains a PLC-system with sockets to connect any to chosen module card. For the sockets there are several switches to simulate faults at the different in- and outputs.

General Data:
Melsec PLC (24V)
8 inputs and 6 outputs
Input and output of the PLC is connected to a 20 pin socket
Dimension: 240 x 140 x 55 mm
Weight: 0.5 kg

AUT 310712 Programming Software for PC with AUT 310145 SC-09 Signal Cable

Programming software GX-Developer for programming of PLC from the PC, with cable suitable for connection between the PC and PLC.
Signal cable - see page 3.

Alternative:
AUT 310070 Hand-Programming Unit with AUT 310160 Cable

Hand-Programming Unit for programming the Melsec PLC system, and cable having connectors suitable for connection between the Hand-Programming Unit and PLC.

General Data:
Dimension: 180 x 85 x 25 mm
Weight: 0.3 kg
**AUT 302001 Simulation Module**
The output signal levels can be altered using the simulation module that is plugged into the sockets of the PLC Module.

**General Data:**
Shows output status with 6 LED and has input signals simulated by 8 on/off switches.
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg

**AUT 302004 Terminal Block Module**
The Terminal Block Module is connected to the PLC-Module. The PLC-Module together with the Terminal Block Module will be used for connection of the Mecha-Kit. The connection will be done with one wire to each output and input. In this case there are 8 inputs and 6 outputs for control of the valves (for the cylinders), vacuum and sensors on the Mecha-Kit.

**General Data:**
Connection between PLC and Lab Equipment
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg

**AUT 302002 Traffic Lights Module**
The Traffic Lights Module is to be connected to the PLC Module. The Module simulates a traffic crossing for cars and pedestrians at a pedestrian crossing.

When experimenting with the Traffic Lights Module, the student gets the task of creating a PLC program to control the traffic lights.

**General Data:**
Dimension: 100 x 140 x 40 mm
Weight: 0.1 kg

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Technical Literature

Mecha-Kit is delivered with a comprehensive laboratory manual in 4 colour print which contains traditional laboratory exercises as well as problem based tasks. For theoretical studies the following technical literature will be supplied.

BOK 300201 Text Book
Contents:
- What is Automation
- Actuators
- Valves
- Grippers
- Sensors
- Control systems
- Automation units
- Hints on commissioning and fault finding
- For practical training we have a laboratory exercise book.

BOK 300200 Laboratory Exercise Book
Contents:
- Equipment explanation
- Cylinder power, setting force
- Deceleration, setting speed and deceleration
- Vacuum, use vacuum to grip
- Measuring fixture
- Pick and Place robot with short movements
- Pick and Place with rotation
- Linear movements
- Assembly station
- Hoist
- Pick and Place with shuttle, rotation device and cylinder
- Self-constructed Pick and Place

Learning objectives
- Mechanics
- Electronics
- Pneumatics
- PLC programming
- Automation
- Sensor technology
- Fault finding
Lists of components in Mecha-Kit

The Mecha-Kit mechanical building unit comprises of the following components:

Profile system
1. Base plate with carrier handle, 600 x 560 mm, no. 1
2. Assembly bracket, low angle and two mounting screws, no. 2
3. Assembly bracket, high angle and two mounting screws, no. 3
4. T-profile, long angle and two mounting screws, nos. 4 and 5
5. T-profile, smaller, no. 6
6. Frame profile, larger, length 506 mm, no. 7
7. Frame profile, larger, length 467 mm, no. 8
8. Frame profile, smaller, length 150 mm, no. 9
9. Frame profile, short, length 55 mm, with T-groove mounting, no. 10
10. Short tube for suction plug, no. 11
11. Long tube for suction plug, no. 12
12. T-groove mountings for profiles
13. Mounting nuts, round, with plastic
14. Mounting for sensors, no. 13

Pneumatic and electrical components
1. Air handling unit 1/4” conn. with shut-off valve, filter, pressure regulator and pressure gauge
2. Manifold lock, with connections
3. Pressure regulator with pressure gauge and non-return throttle valve
4. Double-acting cylinder, Ø 20 mm, stroke 40 mm, complete with mounting plate and mounting nuts
5. Double-acting cylinder, Ø 20 mm, stroke 50 mm, complete with mounting plate
6. Swivel device with 180° swivel, complete with mounting bracket, rotary arm and two PNP sensors
7. Shuttle cylinder Ø 16 mm, stroke 300 mm, complete with subplate and mounting brackets
8. Variable non-return throttle valves, mounted on all cylinder ports
9. Valve unit comprising six unistable valves, electrical control with spring return
10. Manifold block, electrical with starter button
11. PNP sensors, 3-wire
12. Vacuum monitor sensor
13. Ejector, complete with vacuum gauge
14. Plastic ejector, complete with connections
15. Suction pad with nipple
16. Suction pad, bellows type
17. Main air supply valve

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Other components

1 Plastic storage box, 250 x 205 x 40 mm
2 Mountings for ball conveyor
1 Ball conveyor, 600 mm
1 Plastic cup, red Ø 35 x 15 mm
3 Pucks Ø 50 mm, height 30 mm, white, black and metallic
1 Square, 50 mm side, height 30 mm.
4 Wooden balls Ø 22 mm
1 Ball socket
5 Straight connection leads for sensors, 1 m
3 Angle connection leads for sensors, 1 m
4 Sensor mountings with double-acting cylinders
3 Sensor mountings for shuttle cylinder (painted red)
1 Dismantling fork
1 Plastic tube 4 mm, 5 m
1 Spiral hose, single, 4 mm
1 Spiral hose, double, 4 mm
1 Spiral hose, triple, 4 mm
1 Plastic tube clipper
2 Plastic mountings for cable and sensors
1 Screwdriver
1 8mm spanner
3 Hexagon (Allen) keys, 2 mm, 3 mm, 4 mm
2 T-coupling Ø 4 mm
10 Plugs Ø 4 mm
1 Tote box for profile systems and components, with inlay and mounting for tube and spiral hose, 530 x 385 x 120 mm

MT 0415 Compressor

Suitable compressor for Mecha-Kit.
This is a piston type oil-lubricated compressor driven by a single phase electric motor and of fully automatic design.
The compressor works silently and without vibrations.
The compressor is equipped with:
Overload protection
Pressure switch with unloader
Safety valve
Manometer
Drain cock
Filter regulator with 5µm filter

General Data:
Power supply: 220-240V, 50-60Hz 1-ph
Power consumption: 250W
Capacity: 26 l/min at 8 bar
Max. working pressure: 8 bar
Tank size: 15 l

Dimension: 380 x 380 x height 470 mm
Weight: 22 kg

A 5-7 bar compressed air supply is required. If this is not available then the compressor shown above is recommended.
The YO-YO Factory

System Description:

Magazine Quality Control (option) Drilling Sorting Assembly

Technical description:

The YO-YO factory is a flexible training system covering all aspects of automation. It consists of a number of stand-alone laboratory modules which together comprise a small-scale industrial manufacturing plant. The units can be operated independently using a Programmable Logic Controller (PLC) or as an on-line manufacturing plant with a fieldbus systems. (See mode of operation).

Each individual module is manufactured from extruded aluminium and is fitted on a specially designed trolley. The operating panel, power supply and the PLC are located under the top plate on an extractable drawer. The control system and the power supply are connected to the modules by two D-connectors. The modules are operated from a compressed air supply and each module has its own air filter and regulator. Modules can be easily linked together to form different combinations.
The Modules

AU 5510 Magazine Module

The Magazine Module consists of a store made from transparent tube. It is filled by hand with a mixture of yo-yo side discs. They are either black plastic units, white plastic units or aluminium units. An optical sensor detects if the store is empty. A pneumatic cylinder moves the side disc from the store to the next module.

Students learn sequence programming, cylinder force and cylinder speed.

General Data:
Required number of I/O:s 5 in; 1 out.
Equipment:
1 Regulator with filter
3 Sensors, 1 Cylinder, 1 Valve
2 D-connectors, 37-pin
Logic level: +24 V
Working pressure range: 5-7 bar
Max air pressure: 12 bar
Power supply: 100-240 V, 50-60 Hz
Dimension: 590 x 400 x 1180 mm
Weight: 30 kg

AU 5520 Drilling Module

A conveyor belt transports the disc to the central position. The disc is picked up by a suction cup and placed in a pneumatic vice.

An electric drill then drills a hole in the centre of the side disc. The disc is returned to the conveyor belt and moved to the next module or station.

General Data
Required number of I/O:s 13 in; 11 out.
Equipment:
1 Regulator with filter
11 Sensors, 3 Cylinders, 4 Valves
1 Ejector
1 Suction Cup
1 Electrical Conveyor
1 Electrical Drilling Machine
2 D-connectors 37-pin
Logic level: +24 V
Working pressure range: 5-7 bar
Max air pressure: 12 bar
Power supply: 100-240 V, 50-60 Hz
Dimension: 590 x 400 x 1180 mm
Weight: 35 kg

AU 5510 Magazine Module is mounted on a specially designed trolley which is included. (see page 13).

AU 5520 Drilling Module is mounted on a specially designed trolley which is included. (see page 13).
AU 5540 Assembly Module

The Assembly Module receives the drilled and selected Yo-Yo side discs. One of the side discs is held in a station and a steel shaft is pressed into the drilled hole.

A second disc (different colour from the first) is then placed in the assemble station and pressed onto the other end of the steel shaft.

Students learn location and assembly processes and how these are effected by force and pressure.

**General Data:**
- Required number of I/O:s: 16 in; 12 out.
- Equipment:
  - 1 Regulator with filter
  - 14 Sensors
  - 6 Cylinders, 7 Valves
  - 2 D-connectors 37-pin
- Logic level: +24 V
- Working pressure range: 5-7 bar
- Max air pressure: 12 bar
- Power supply: 100-240 V, 50-60 Hz
- Dimension: 590 x 400 x 1050 mm
- Weight: 33 kg

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AU 5550 Quality Control Module (optional)
The Quality Control Module receives the Yo-Yo side discs from the store station magazine. A shuttle cylinder with a rotary disc moves the side discs to a thickness measuring station having analogue output. If accepted they are then passed by an inductive sensor to determine the material of the side discs. Side discs of the wrong material or incorrect thickness are routed down rejection chutes. Correct units which are black and white plastic discs are moved to the next module. Students learn to program analogue units to determine the thickness and inductive units to determine the material using the PLC and mechanical settings.

General Data:
- Required number of I/O:s: 12 in; 6 out, 1 in; 1 out; analogue
- Equipment: 1 Regulator with filter
- Logic level: +24 V
- Working pressure range: 5-7 bar
- Max air pressure: 12 bar
- Power supply: 100-240 V, 50-60 Hz
- Dimension: 590 x 400 x 1000 mm
- Weight: 40 kg

AU 5591 I/O Module
The I/O module is required to operate the different modules either by PLC, Profibus or Scada Control. The I/O Module is fitted on a panel that can easily be pulled out from the trolley. The PLC, D-connectors, power supply and relay for emergency stop are mounted on the panel.

The PLC must be ordered separately. Solutions for the most common PLC's are available.

General Data:
- Base: Anodised aluminium plate
- Equipment: Switched power Supply 24V DC 2A
- Power supply: 100-240 V, 50-60 Hz
- Dimension: 500 x 295 mm
- Height: Depends on PLC
- Weight: Depends on PLC

AU 5592 Control Panel
Every Module equipped with PLC needs a Control Panel. The Control Panel is constructed from light aluminium plate and can be easily pushed into the Trolley. See page 13.

General Data:
- Operating functions: Power ON, Power OFF
- Lamp indication: Power ON
- Dimension: 290 x 95 x 55 mm
- Weight: 1 kg
MT 1225 Compressor
This is a piston type oil-lubricated compressor driven by two single phase electric motors and is of fully automatic design. The compressor works silently and without vibration.

Equipment:
- Overload protection
- Pressure switch with unloader
- Safety valve
- Manometer
- Drain cock
- Filter regulator with 5 µm filter

General Data:
- Power supply: 220-240 V, 50-60 Hz 1-ph
- Power consumption: 680W
- Capacity: 64 l/min at 8 bar
- Max. working pressure: 8 bar
- Tank size: 25 l
- Dimensions: 400 x 410 x height 590 mm
- Weight: 45 kg

Other supply voltages available on request.

Technical Literature
BOK300301 Module A Magazine, Laboratory Exercises
BOK300302 Module B Quality Control, Laboratory Exercises
BOK300303 Module C Drilling, Laboratory Exercises
BOK300304 Module D Selection, Laboratory Exercises
BOK300305 Module E Assembly, Laboratory Exercises
BOK300312 Module B Quality Control, Technical Manual
BOK300313 Module C Drilling, Technical Manual
BOK300314 Module D Selection, Technical Manual
BOK300315 Module E Assembly, Technical Manual

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**AU 5595 SCADA Module**

SCADA (Supervision Control And Data Acquisition) is the general term for a large group of computer systems with special Capabilities. It is typical that SCADA is used in industrial applications to control and supervise processes in real time.

*The picture above shows SCADA screen prints of the drilling process.*

Terco SCADA enables students to enter and observe data operations throughout the process. Actual measurements are presented in real time on the computer screen. Control signals may be changed during the process. The SCADA system provides automatic control of the process. During the process a history of the program is generated which can be saved to be used for future operations. All events can be stored and afterwards checked with the results appearing on the students record. The system allows the teacher to insert faults that the student has to locate and correct during operation. The system can be programmed for remote control through the Internet or an Intranet or other corresponding networks. This enables Schools or Institutions on the internet to deliver distance learning based on the operational functions of the YO-YO factory.

**In practice:**
- Screen display of the complete process as and when it occurs.
- Control of all the different modules, observation and modification of the sensor operations.
- Use of a professional SCADA System based on Profibus and Fix Intellution.

**Technical data SCADA Module:**

- Computer unit with a Profibus interface and Fix Intellution software installed for 150 nodes.
- AD/DA units, Multiplexers and Modules for Series communications with PC through I/O:s digital IN and OUT and analogue IN and OUT.
- Fully integrated Man Machine Interface
- Provides remote control of sensors and valves, and contactors.
- Display of all relevant parameters
- Replicates all YO-YO factory configurations
- Easy schematic customisation.
- Digital virtual instrumentation.
- Event logging and filing
- Alarm setting
**Mode of Operation**

**One PLC**

![Diagram of one PLC](image)

**4 PLC’s (5 if the Quality Control option is selected)**

By including a control module, each module can be operated individually. The PLC module includes the I/O module.

![Diagram of 4 PLC's](image)

**Profibus / SCADA**

The Slave includes I/O for SCADA

![Diagram of Profibus / SCADA](image)

**How to order**

The Yo-Yo Factory can be ordered as separate modules with or without a PLC. The equipment can be ordered complete with one PLC as a complete manufacturing plant or with 4 or 5 PLC:s, one for each module.

Installation and training at site or in our factory is optional. Each module is provided with training and instructional software.
ADDITIONAL CONTROL OBJECTS

AUT 300050 Automatic Laundry Model
The TA-1 automatic laundry is a process model suitable for control and measuring technique training with a PLC system and computer. One of the big advantages of this automatic laundry is that most people are familiar with the workings of the actual “process” – a washing machine programme, and can therefore proceed more quickly to the business of structuring and programming their own process.

General Data:
The TA-1 is a model of a full-sized modern washing machine, offering a wide spectrum of potential control functions.

These include:
- Sequential control
- Motor control
- Level control
- Temperature control, ON/OFF and analogue.

The digital IN and OUT terminals can alternate between 24 V and 5 V logic, which means that the TA-1 can be controlled by a PLC system or directly by a computer with TTL-I/O functions.

The automatic laundry has 10 inputs and 10 outputs, including 8 digital and 2 analogue:
- Dimension: 260 x 260 x 300 mm
- Weight: 6.5 Kg

AUT 300080 Lift Model
This model is intended as a control object for programming exercises with a control system, PLC or computer. The process consists of a lift cage to be moved between four levels. The pushbuttons at each level and inside the lift cage have LEDs for indication.

General Data
- Inputs: Power supply 24V DC
- Lift up
- Lift down
- 8 LEDs (acknowledgement)
- Outputs: 8 Push buttons
- 4 position indicators
- Logic level: 24 V DC
- Connection: Via terminal block or two 37 - pin D - connectors for quick connection to I/O Module (AU 5591) See page 16.

- Dimensions: 340 x 405 x 650 mm
- Weight: 9 Kg

PLC Systems for the additional control objects will be quoted on demand.
Terco Headoffice

Terco headoffice and factory outside Stockholm, Sweden.