

EDITION 2

INSTRUMENTATION / PROCESS CONTROL / MECHATRONICS ENGINEERING

AMTEC TECHNIQUIP
Engineering The Future



Suppliers Of Educational Engineering
Equipment & Accessories





Amtec Techniquip applies 30 years of knowledge & experience in the design, manufacture and import of educational engineering equipment, accessories, instrumentation and consumables.

During this time, we have been a market leader in innovation, bringing many new concepts and products to the educational industry while expanding our comprehensive range of quality teaching equipment to a level unsurpassed by any other company in the industry.

This includes unique new methods of introducing and educating the learners in all facets of modern engineering. Our products are visual and demonstrational to best teach and explain concepts from basic engineering, all the way up to research and thesis levels in the most advanced forms of engineering.

Amtec Techniquip's commitment to the end user...

AMTEC offers a personal approach to each and every end user as we are always available to meet and discuss any requirements face-to-face basis to provide a tailor-made solution.

AMTEC have a large footprint throughout Southern Africa and regularly visit the countries and provinces we service while also keeping our customers up-to-date with any new products and innovations we bring to the market.

AMTEC supplies expert training on all our products. Our team of experts offer training at the end user or alternately at our head office in Jhb. All our products are supplied with their relevant manuals, course materials and exercise guides.

AMTEC offers unmatched after-sales service and customer support. All our equipment is supplied complete with ICT (Installation, Commissioning & Training). Our sales and support teams are at the end user's disposal should any assistance be needed during the life of a product.

AMTEC offers an extended Service and Maintenance plan to make sure that your equipment and apparatus are maintained to ensure a long lifespan with little or no downtime.

AMTEC makes use of only quality components to ensure reliability and longevity of all our manufactured equipment. This provides the end user with peace of mind and a product that will stand the test of time in an educational environment.

AMTEC has the manufacturing capability to R+D and manufacture "one-off" designs and customise any equipment within our range to meet the end users requirements. We have many accessories, add-ons and tooling that can work in conjunction with our equipment and trainers.

AMTEC offers a 24-month factory warranty on all our products supported by the backing of our local & international suppliers.



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AMTEC AUTOMATION

AMTEC HMI / PLC TRAINERS

AMTEC Techniquip manufactures a variety of HMI & PLC Trainers for the fundamentals to advanced fault recognition.

Amtec Basic HMI Trainer:

- Designed to teach students connectivity to HMI and HMI Programming
- Includes Manuals
- Includes Software
- Includes Cables from PC-HMI
- Variety of HMI's available (Delta, Lovato, Schneider, Siemens etc.)
- Includes Program that Tests all components on HMI are functional
- On request, free of charge includes Training basic and advanced



AMTEC PLC TRAINERS

Amtec PLC Trainer – Programming, Interface & Simulation



Amtec Techniquip has designed and developed PLC Trainers using various PLCs used in industry. The PLC Trainers are prewired so as to allow the unit to withstand everyday use in the classroom, workshop or laboratory. The Trainer has both Switches and LED Lamps for use as a stand-alone unit, however the unit can also be interfaced to external equipment.

All units are supplied with the software and programming cable.

Intermediate PLC desktop trainer that focuses on Programming, Interface and Simulation. It is enclosed in a powder coated sheet metal enclosure, with a silk-screen printed façade labelling all components and connection points

- Schneider PLC Zelio including software and data cable
- Inputs triggered by 8xx SPST switches for demonstration of various PLC logics, Ladder diagrams and Function block diagrams
- 8xx Corresponding 16mm pilot lights to signal trigger with SPST switches
- 4xx 16mm pilot Indication lights
- Easy connection via plug in safety sockets and leads
- Unit can be used stand-alone or can be interfaced to various hardware such as motor, signal tower, conveyor belt, elevator simulator and other PLC controlled modules.
- Desktop unit for use in the classroom, laboratory or workshop
- Supplied with complete user manual and sample exercises
- 24V dc supply for user safety
- Mounted to robust epoxy powder coated enclosure.
- Safe & Reliable
- Supplied with Single phase plug for connection to mains

Optional Accessories

Amtec HMI Simulation Module – Allows the user to interface the various I/O's to and HMI with preloaded virtual experiments

PLC Brands Available:

- Delta
- Schneider
- Siemens
- Lovato
- Mitsubishi

Dimensions & Weight:

- 300mm (l) x 250mm (d) x 150mm (h)
- 4.5Kg

AMTEC PLC TRAINERS

Amtec PLC Trainer – Programming, Simulation, Interface and Wiring Type



OVERVIEW

Amtec Techniquip has designed and developed PLC / Programmable Logic Controller Trainers using various PLC's used in industry. The PLC is prewired so as to allow the unit to withstand everyday use in the classroom, workshop or laboratory. The trainer includes a number of components commonly used as input devices and output devices to allow the unit to be a stand-alone set allowing the user to familiarise himself / herself with programming a PLC, Loading the program, and connecting the PLC to various components. The unit can also be used as a stand-alone module and interfaced to external equipment.

Advanced PLC desktop trainer that focuses on Programming, Interface, Simulation and Wiring. It is enclosed in a powder coated sheet metal enclosure, with a silk-screen printed façade labelling all components and connection points

- Schneider PLC Zelio including software and data cable
- Control components used for demonstration of various PLC logics, Ladder diagrams and Function block diagrams are available as follows:
 - o 12xx Digital Inputs
 - o 8xx Relay Outputs / Digital
 - o 6xx Switches as SPST & Push-to-make function
 - o 1xx Plunger limit switch
 - o 1xx Roller limit switch
 - o 1xx Lever limit switch
 - o 8xx Coloured pilot lights
 - o 1xx Electromagnetic counter
 - o 1xx 24V DC Buzzer
 - o 2xx 24V DC Motor
- Trainer is set up to simulate:
 - o PLC Motor control
 - o Traffic light intersection
 - o Elevator simulation
 - o Mini process control
- Easy connection via plug in safety sockets and leads
- Unit can be used stand-alone or can be interfaced to various hardware such as motor, signal tower, conveyor belt, elevator physical simulator and other PLC controlled modules.
- Desktop unit for use in the classroom, laboratory or workshop
- Supplied with complete user manual and sample exercises
- 24V dc supply for user safety
- Mounted to robust epoxy powder coated enclosure.
- Safe & Reliable
- Supplied with Single phase plug for connection to mains

OPTIONAL ACCESSORIES:

Amtec HMI Simulation Module – Allows the user to interface the various I/O's to and HMI with preloaded virtual experiments

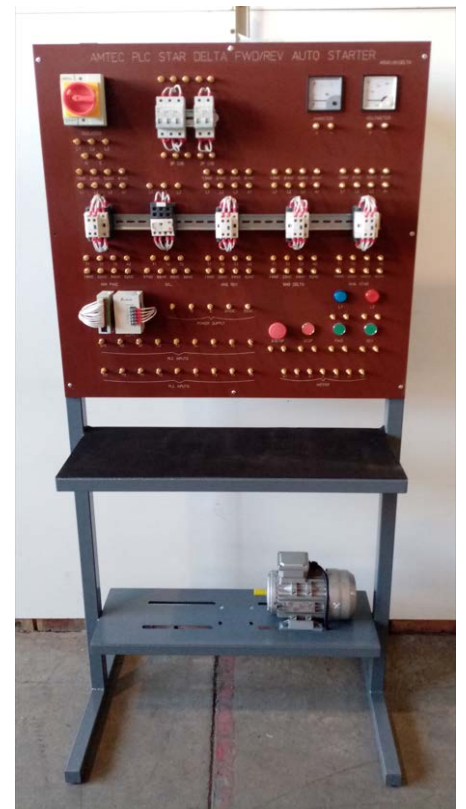
Amtec Traffic Light simulator:

- Designed for application of programs to real life situations
- Includes Manuals
- Includes Software
- Includes communication Cables from PC-PLC
- Variety of PLCs available (Delta, Lovato, Schneider, Siemens etc.)
- Includes simulation example programs
- Includes Program that Test all components on PLC are functional
- On request, free of charge includes Training basic and advanced



Amtec Combination PLC STAR/DELTA FWD/REV:

- Designed for various motor starting sequences via PLC
- Includes Manuals
- Includes Software
- Includes Cables from PC-PLC
- Variety of PLCs available (Delta, Lovato, Schneider, Siemens etc.)
- Includes Program that Test all components on PLC are functional
- On request, free of charge includes Training basic and advanced



Amtec is in partnership with major PLC brands:



Allen-Bradley



HITACHI
Inspire the Next

AMTEC PLC TRAINERS

AMTEC Conveyor belt PLC module



De Lorenzo Elevator PLC module



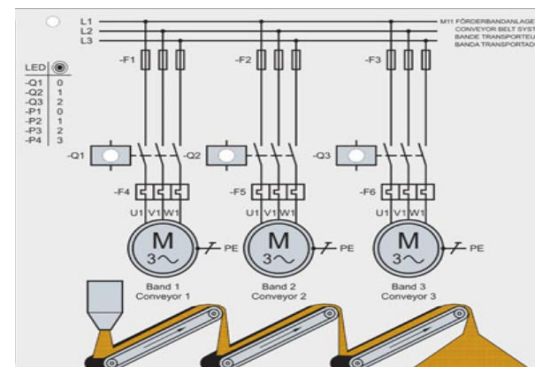
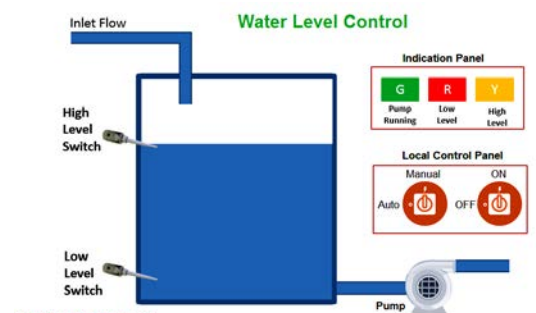
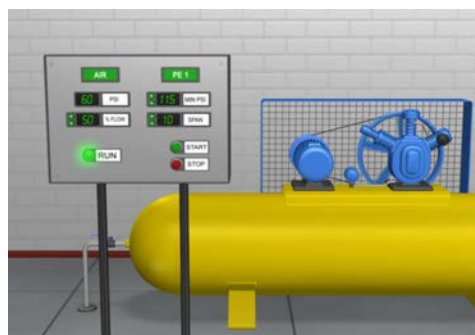
DL 2122M

AMTEC Signal tower PLC module



Simulated PLC Scenarios

- HMI controller
- Alarms
- Gas detector
- Passive infrared sensor
- Perimeter sensor
- Blinker
- Motion switch
- Day/night switch
- Position sensor
- Capacitive proximity sensor
- Photoelectrical barrage sensor
- Photoelectrical reflecting sensor
- Level magnetic sensor
- Pulse counter
- Smoke detector
- Temperature controller
- Brightness controller
- Shutter actuator
- Infrared transmitter



The programmable logic controller (PLC) allows controlling machines and installations by using the sequential logic that replaces the traditional electromechanical boards, allowing, therefore, to save relays, timers and counters. Moreover, the main advantages in the use of the PLC are the flexibility, because they can be re-programmed, the industrial characteristics, thanks to the possibility of their use in environments with heavy working conditions, the reliability and the safety, typical of the solid state technology that has no moving contacts, as well as the possibility to process analogue signals.

PROGRAMMABLE LOGIC CONTROLLER – 36 IN/28 OUT



DL 2210B

The DL 2210B unit is a programmable controller that combines high performances and ease of use for those who are approaching for the first time the world of PLC.

The proposed configuration includes:

- CPU with 14 digital inputs, 10 relay outputs and 2 analogue inputs
- module with 16 digital inputs and 16 relay outputs
- module with 4 analogue inputs and 2 analogue outputs

The unit is fitted in an accessible container while on the panel the input/output terminals are shown, suitably duplicated by means of connectors.

The DL 2210B is complete with the programming software.

PROGRAMMABLE LOGIC CONTROLLER – 26 IN/22 OUT



DL 2210A

This unit has technical and functional characteristics similar to the ones of the DL 2210B, but it is composed of a CPU with 24 digital inputs, 2 analogue inputs and 22 relay outputs. Complete with the programming software.

PROGRAMMABLE LOGIC CONTROLLER – 12 IN/8 OUT



DL 2110AH

Easy to be programmed from its own panel, without computer.

It is composed (including the extension module) of 12 digital inputs and 8 relay outputs.

Simulation of the inputs through switches and externally through terminals.

The programming software is also supplied to allow programming the PLC from the computer, if so preferred.

PROGRAMMABLE LOGIC CONTROLLERS MODULAR TRAINER



**DL 2110-131K
(without PLC)**

**PLC options:
DL 2110-131K-MTB
DL 2110-131K-AB
DL 2110-131K-1200**

This modular trainer allows the study of the PLC and HMI. The modular frame is a tubular steel structure, treated with electrostatic painting. It has 4 lines for manual and fast fixation of the modules without the need for tools. All terminals and connection points are available through 2 or 4 mm. terminals (according to the voltage). The components, as well as their terminals and access points, are identified with the respective symbol printed in silk-screen.

- PLC module: MITSUBSHI Fx1n series or Allen-Bradley(AB) Micro830 series or Siemens S7-1200 series or Siemens S7-200 series.
- PLC developing software can run on following operation system: Windows XP, Windows 7 or Windows 8.
- 7 inch HMI. Resolution: 800x480, 16bit colour, touch screen: 4 wires.
- Input power module, with protection switch and lights.
Power supply: single-phase from mains.
- Power supply module with polarity inversion and over-current protection.
Outputs: 12 Vdc, 24 Vdc and 0 ÷ 10 Vdc.
- Module with switches for digital input signals simulation. It includes 8 fixed contact switches with retention, NC/NO, for simulating the logic levels.
- Module with switches for digital input signals simulation. It includes 8 contact pulse switches, NC/NO.
- Module with switches for digital input signals simulation. It includes 4 contact pulse switches, NC/NO and 4 contact retention switches, NC/NO.
- Module with 8 led for light indication of output digital signals, suitable for PLC with NPN or PNP outputs.
- Module with 2 linear potentiometers for simulation of voltage or current signals (4 to 20 mA and 0 to 12 Vdc).
- Module for analogue signals measurement. Possibility to measure 2 signals simultaneously. One of the inputs is suitable for current signals from 4 to 20 mA and the other for voltage signals from 0 to 10 Vdc.
- Module with step motor, with 4 bit electronic driver, with light indication for each bit.
- Module with 4 relays for 10 A and 24 Vdc coil, suitable for PLC with NPN or PNP outputs.
- Module with DC motor and encoder, suitable for PLC with NPN or PNP inputs.
- Module with Analogue/Digital converter, 8 bits A/D converter, with analogue signals input from 0 to 10 Vdc or from 4 to 20 mA.
- Module for Digital/Analogue converter, 8 bits D/A converter, with maximum analogue output signals adjustable from 0 to 10 Vdc or from 4 to 20 mA.

Supplied with a set of 30 connection cables, 2 and 4 mm, and an experiment manual.

PLC S7-1200 TRAINING PANEL



DL 2210AS

Layout:

- 16 switches (retentive and pulse) for DI(simulate) and 16 x 4mm safety sockets for external DI
- 16 x 4mm safety sockets for DO signals with state display via LED
- 4 x 4mm safety sockets for analog inputs AI0...3 both for voltage control (0...10V; 0...5V; 0...2.5V) and potentiometers for analog signal simulation (activated via switch)
- 2 x 4mm safety sockets for analog outputs
- 4 potentiometers for signal generation(simulate analog channel input in voltage -10...+10V)
- 2 x 4mm safety sockets for measuring AI/AO selected via dedicated 6-way switch
- 1 x seven-segment display for AI/AO
- 2 x SYSLINK connectors for DI/DO (A, B)
- 1 x SYSLINK connectors for AI/AO (C)
- 2 pairs of 4mm safety sockets for powering external equipment via 24VDC output

Technical data:

CPU

SIEMENS SIMATIC S7 1200 (CPU 1214C):

- -40 ... +70 degrees C with conformal coating
- Onboard I/O: 14 DI 24V DC; 10 DO 24 V DC; 2 AI 0 - 10V DC
- Power supply: DC 20.4 - 28.8 V DC
- Program/data memory: 75 KB

DIGITAL INPUT/OUTPUT

SIEMENS SIMATIC S7-1200 DIGITAL I/O SM 1223 MODULE:

- Digital I/O Module: 8DI/8DO
- 8DI DC24 V, Sink/Source, 8DO, transistor 0.5A

ANALOG INPUT/OUTPUT

SIEMENS SIMATIC S7-1200 ANALOG I/O SM 1234 MODULE:

- Analog I/O Module: 4AI/2AO, +/- 10V 14 bit resolution or 0(4) - 20 mA, 13 bit resolution

POWER SUPPLY

SIEMENS SIMATIC S7-1200 POWER MODULE PM 1207:

- Stabilized Power Supply
- Input: 120/230 V AC
- Output: 24 V DC/2.5 A

The **PLC S7-1200 TRAINING PANEL** Training Panel is a powerful didactic tool used in academic courses.

It's offers outstanding system performance for short response times, the highest control quality and is also both technologically and security integrated.

AMTEC PROCESS CONTROL BENCH TRAINERS



PROCESS CONTROL TRAINER

The trainer is composed of:

- an educational board with a pressurized vessel and a set of sensors and actuators for level, pressure, temperature and flow;
- a control module, containing the interface circuits for the sensors and the actuators and the ON/OFF, proportional, integral and derivative control circuits (PID).

TECHNICAL FEATURES

Pressurized vessel capacity: 5 litres approx.

Water tank capacity: 20 litres approx.

Temperature sensors:

- platinum thermo-resistance Pt 100
- bi-metallic direct reading thermometer

Level sensors:

- linear variable-differential transformer (LVDT)
- on-reed ON/OFF sensor

Flux sensors:

- flowmeter 8000 pulses/ litre
- flowmeter, direct reading

Pressure sensors:

- strain gauge
- manometer, direct reading

Recirculation pump: 6 litres/minute, 12 V, 1.5 A

Motor driven valve

4 manual valves

Water heating resistance: 48V, 200W

Safety valve set at 2.4 bar

Safety thermostat

Piping: brass

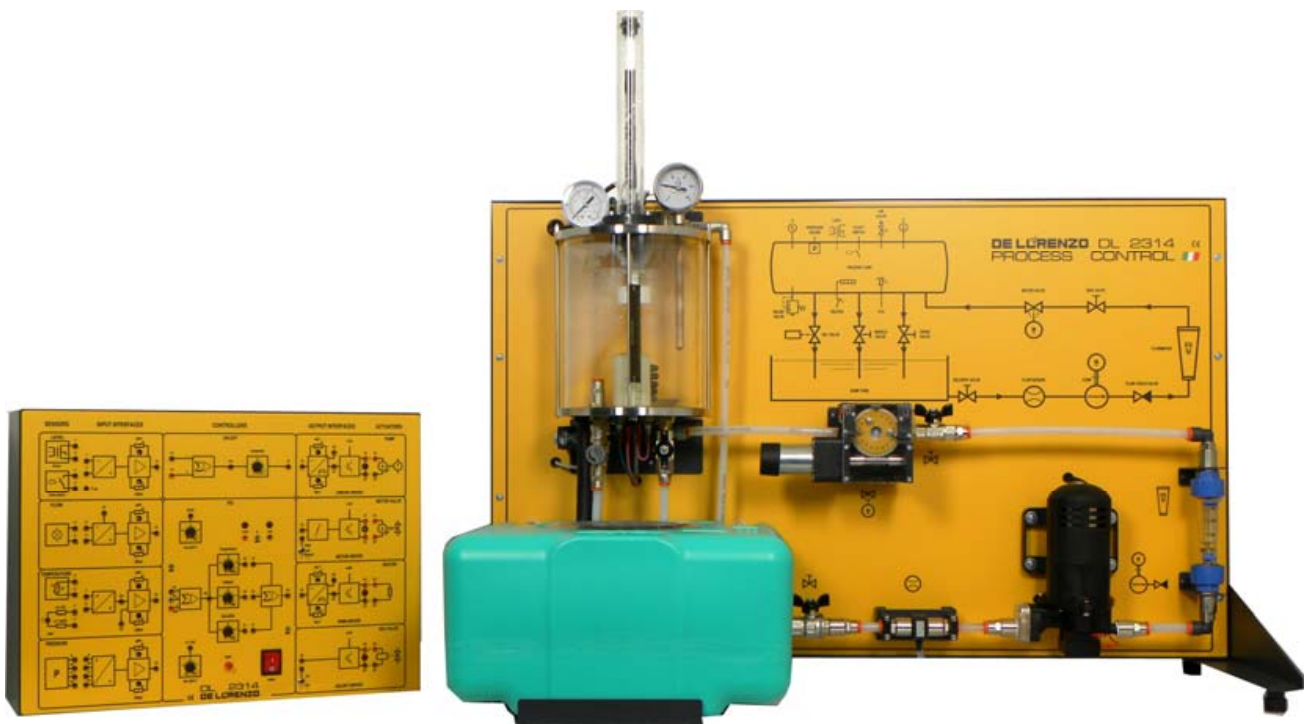
Power supply: single-phase from mains

With this system, the student will be able to study the following:

- Study of the level, flow, pressure and temperature sensors
- Study of the characteristics of the pump and of the motor pump
- Study of the characteristics of the static process and of the time constants
- ON-OFF, P, PI, PD and PID closed loop control of the level
- P, PI, PD and PID closed loop control of the flow
- ON-OFF, P, PI, PD and PID closed loop control of the temperature
- ON-OFF control of the level with the pressure sensor

Optionally, it is possible to connect to the trainer:

- a microprocessor based process controller of industrial type (DL 2314C)
- a process recorder (DL 2314R)
- a programmable logic controller (DL 2210B)
- a personal computer with suitable interface module and software (PC with DL 1893 and DL 2314SW)



PROCESS CONTROL SIMULATION SOFTWARE

Simulation software in LabVIEW environment.

The simulator is composed of two parts: the controller and the system to be controlled.

Controller

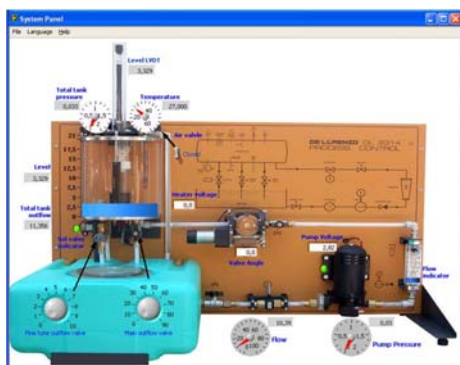
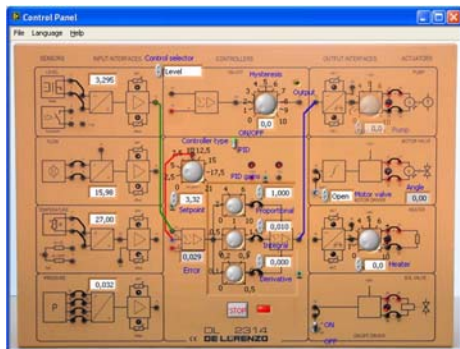
The user can influence the behaviour of the system through the controller. The system is controlled by the following parameters of the actuators:

- Pump: input voltage (0V to 10V)
 - Motor driven pump: angle (0° to 40°)
 - Heating resistance: input voltage (0V to 10V)
- and in the process tank:

- Manual output valve 1: angle (0° to 90°)
- Manual output valve 2: number of rpm
- Solenoid valve: on or off
- Air valve: on or off

The controller is composed of PID and On/Off controls that are used to control the temperature of the water, its pressure and its level inside the process tank.

The parameters can also be manually controlled.



DL 2314SIM

System to be controlled

The system is composed of a didactic plant that consists in a pressurized process tank, a storage tank and a set of sensor and actuators for level, pressure, temperature and flow.

The behaviour of the system is modeled on the basis of the characteristics of the physical components. Under a given supply voltage, the pump creates a flow of water that also depends on the pressure in the system. In the process tank some amount of water may be stored and exert a hydrostatic pressure at the bottom. The process tank is also equipped with an air valve that can be used to control the pressure of the air inside the tank.

The output pressure from the tank is, therefore, the sum of the hydrostatic pressure and of the air pressure. The temperature of the water inside the process tank can be controlled by means of a heating resistance. To influence the pressure in the system also the valves may be used. The storage tank is used to store water for the system and there is atmospheric pressure at its output.

The simulator calculates and presents to the user the following parameters:

- Flow in the system
- Outflow from the process tank
- Pressure exerted on the pump
- Total pressure at the output of the tank
- Level of the water in the process tank
- Temperature of the water in the process tank

INTRODUCTION

This laboratory has been designed to introduce the fundamentals of automatic control technology. The main functions of processes, controllers and controlled systems are shown on a simulated controlled system, as well as the interactions between the transfer elements of a control loop.

Before dealing with the experimental part, the manual offers to the students the synthesis of the basic concepts relevant to the automatic control in order to develop to the best experimentations of this laboratory.

The theoretical topics described in the manual are:

- *General Definitions*
- *Graphical representation of control systems*
- *Subdivision of control systems*
- *Canonical form of systems driven back*
- *Canonical functions and characteristics of control systems*
- *Analysis and design of control systems*
- *Proportional action (P)*
- *Integral action (I)*
- *Derivative action (D)*
- *PID combined action*
- *Preparing the Controller*

The individual components are represented on the panels together with the standard block circuit diagrams. The laboratory has been functionally divided in a number of sections, so that the student can follow a proper educational path, with increasing difficulties from theory to practical applications. The sections have been set up as follows:

Fundamentals of Automatic Control Technology

<i>Processes</i>	<i>PRO</i>
<i>Controllers</i>	<i>PID</i>
<i>Continuous Automatic Control</i>	<i>CAC</i>
<i>Discontinuous Automatic Control</i>	<i>DAC</i>

Applications

<i>Control of a DC motor</i>	<i>MOT</i>
<i>Temperature control</i>	<i>TEM</i>
<i>Light control</i>	<i>LUM</i>
<i>Level control</i>	<i>LEV</i>
<i>Flow control</i>	<i>FLO</i>



FUNDAMENTALS OF AUTOMATIC CONTROL TECHNOLOGY

Processes - PRO

In this experimental chapter the student can analyze the typical behaviours of the processes: the transfer characteristics, the behaviour in transitory conditions, the time constants, the 1st and 2nd order processes, the higher order processes, the dead time, etc.

The knowledge of the typical characteristics of the process is extremely important for a correct approach to the design of a control system.

For such reason, before studying the typical behaviours of the controllers, it is necessary to analyze all the possible characteristics that the process to be controlled can practically have.

The processes that are analyzed in this chapter are the following:

- *P type process*
- *I type process*
- *I² type process*
- *1st order processes*
- *Processes of order highest than the 1st*

Controllers - PID

In this experimental chapter the student can analyze the characteristics and the typical behaviours of the controllers: linearity, proportionality, dynamic behaviour, gain, conventional values, critical frequency, phase, etc.

After having analyzed the single P, I and D elements, he can study their PI, PD and PID combinations and he can set up both series and parallel configurations.

The knowledge of the typical characteristics of the controllers is extremely important for a correct approach to the design of the control systems.

The controllers that are analyzed in this chapter are the following:

- *P Controller*
- *I Controller*
- *D Controller*
- *PI Controller*
- *PD Controller*
- *PID Controller*

Continuous Automatic Control - CAC

After the experimental chapters where the characteristics and the typical behaviours of processes and controllers have been deeply analyzed, we open here a new chapter where processes and controllers are suitably combined to simulate and to study the most common problems related to the Continuous Automatic Control.

The analysis of the interactions between controllers and processes is complicated by the possible presence of noise; sometimes, the latter can trigger a series of oscillations with consequences, potentially serious, for the process. In this chapter, in addition to the analysis of the interactions between controllers and processes, the student can study the causes of the above mentioned instabilities, in order to find possible solutions.

The topics that are covered in this chapter are the following:

- *P control of a P type process*
- *P control of 1st, 2nd, 3rd and 4th order processes*
- *I control of 2nd order and I type processes*
- *P, PD, PI and PID controls of a high order process: stability and optimization*
- *P, PD, PI and PID controls of a high order process: presetting of the parameters according to Ziegler-Nichols (dynamic method)*

- *P, PD, PI and PID controls of a high order process: presetting of the parameters according to Chien-Hrones-Reswick (static method)*
- *P, PD, PI and PID controls of a high order process: parallel and series configuration*

Discontinuous Automatic Control - DAC

After the experimental chapters where the characteristics and the typical behaviours of processes, controllers and continuous automatic control systems have been deeply analyzed, we open here a new chapter where the Discontinuous Automatic Control systems are simulated and analyzed; in these systems the controller is composed of a an element with discontinuous intervention.

A discontinuous controller is characterized by an output having two or more fixed states and its value is switched among these states according to the input value.

The topics that are covered in this chapter are the following:

- *Two position controllers, three range controllers*
- *Sampling acquisition techniques*
- *The two position controller in a 1st order process*
- *The three range controller in a 2nd order process*
- *The two position controller with delayed feedback in a 2nd order process*
- *The two position controller with elastic feedback in a 2nd order process*
- *The sampling control in a 4th order process*

APPLICATIONS

At the end of the experimental chapters dedicated to the analysis and testing on: Processes, Controllers, Continuous Automatic Control, Discontinuous Automatic Control, we can consider as completed the theoretical-experimental knowledge acquisition which is necessary for the practical application to be performed on real processes.

The Laboratory Experiments that are proposed in this section form a working path purposely structured in order to stimulate students to the application of what has been learned in the previous chapters.

In this way we want to educationally involve the students in the search for the most suitable solution for that particular type of control of the real process under evaluation.

Control of a DC motor - MOT

- *P, PI and PID controls of the speed of a DC motor using the CHR method*

Temperature control - TEM

- *The two position controller in the temperature process*
- *The two position controller with delayed feedback in the temperature process*
- *The two position controller with elastic feedback in the temperature process*
- *The three range controller in the temperature process*
- *P, PI and PID controls of the temperature process using the CHR method*

Light control - LUM

- *P, PI and PID light controls using the CHR method*

Level control - LEV

- *P, PI and PID level controls*

FLO

Flow control

- *P, PI and PID flow controls*

List of modules for experiments:

MODULES EXPERIMENTS	DL 2613	DL 2614	DL 2622	DL 2670	DL 2671	DL 2672	DL 2673	DL 2674	DL2675	DL 2676	DL 2677	DL 2678	DL 2679	DL 2680	DL 2681	DL 2682	DL 2625	DL 2684	DL 2685	DL 2686	DL 2687	DL 2688	DL 2689	DL 2690	DL 2691	DL 2692	DL PS-MOD	DL PP-MOD	DL 2109D33	OSCILSCOPE	DL 1155ACT	DL 2100-3M	
PROCESSES																																	
Type P	1								1												1									1	1	1	
Type I	1								1												1									1	1	1	
Type I ⁺	1								1												1									1	1	1	
1st order	1								1												1									1	1	1	
Higher than 1st	1								2												1									1	1	1	
2nd order	1									1	1										1									1	1	1	
CONTROLLERS																																	
Controller P	1			1																	1									1	1	1	
Controller I	1				1																1									1	1	1	
Controller D	1					1															1									1	1	1	
Controller PI	1			1	1			1													1									1	1	1	
Controller PD	1			1		1		1				1									1						1			1	1	1	
Controller PID	1			1	1	1		1													1									1	1	1	
Controller PID with regulation of offset	1			1	1	1		1									1				1									1	1	1	
CONTINUOUS AUTOMATIC CONTROL																																	
Regulation P, process type P	1	1		1				1		1																				1	1	1	
Regulation P, process of 1st order and superior	1	1	1							2																		1		1	1	1	
Regulation I , process 2nd order	1	1			1			1		1																			1	1	1	1	
Regulation P, PD, PI e PID, process of high order	1	1	1							2																	1	1		1	1	1	
Ziegler-Nichols method	1	1	1							2																	1	1		1	1	1	
Chien-Hrones-Reswick static method	1	1	1							2																	1	1		1	1	1	
Parallel and series configuration	1	1		1	1	1	1	1	2																			1		1	1	1	
DISCONTINUOUS AUTOMATIC CONTROL																																	
Controllers with 2 positions, controllers with 3 ranges	1	1						1				1	2																	1	1	1	
Techniques of acquisition and sampling	1													1							1									1	1	1	
Controller with 2 positions, process of 1st order	1	1							1				1															1		1	1	1	
Controller with 3 range, process of 2nd order	1	1						1	1			1	2															1		1	1	1	
Controller with 2 positions, process of 2nd order, delayed feedback	1	1						1	2				1														1	1		1	1	1	
Controller a 2 positions, process of 2nd order, elastic feedback	1	1						1	2				1															1		1	1	1	
Controller with sampling, process of 4th order	1	1	1						2					1														1		1	1	1	
CONTROL OF A DC MOTOR																																	
Regulation P, PI e PID of speed in a DC motor, CHR method	1	1	1	1											1			1										1		1	1	1	
Control of a generator	1	1	1	1											1	1		1										1		1	1	1	
TEMPERATURE CONTROL																																	
Controller with 2 positions	1	1											1					1	1											1	1	1	
Controller with 2 positions, delayed feedback	1	1						1	1				1					1	1								1	1		1	1	1	
Controller with 2 positions, elastic feedback	1	1						1	1				1					1	1									1		1	1	1	
Controller with 3 ranges	1	1						1				1	2					1	1									1		1	1	1	
Regulation P, PI e PID of temperature, CHR method	1	1	1															1	1									1		1	1	1	
LIGHT CONTROL																																	
Regulation P, PI e PID of light, CHR method	1	1	1															1		1								1		1	1	1	
LEVEL CONTROL																																	
Pump's features	1	1																1				1	1						1		1	1	
Measurement system's features	1	1																1				1	1	1					1		1	1	
Level process features	1	1																1				1	1	1					1		1	1	
Level control with adjuster P	1	1		1				1				1						1				1	1	1					1		1	1	
Level control with adjuster PI	1	1		1	1			1	1			1						1				1	1	1					1		1	1	
Level control with adjuster PID	1	1	1									1						1				1	1	1			1		1		1	1	
Level control with a 2 position controller	1	1																1				1	1	1					1		1	1	
FLOW CONTROL																																	
Measurement system's features	1	1																1				1	1		1				1	1	1	1	
Analysis of flow control features	1	1	1	1														1				1				1	1	1		1		1	1
TOTAL																																	
	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TE37

CONTROL AND INSTRUMENTATION STUDY STATION

A laboratory-scale model of a typical industrial process plant providing the essential facilities to allow flow level temperature and pressure control. Demonstrates applications of advanced control systems using industry-standard instrumentation and controls for the training of plant technicians and process control engineers.



- Genuine industry-standard instruments and controls
- Patch panel with leads for quick and simple connection between instruments, valves and controls
- Optional distributed computer control (TE37DCS)
- Gives academic and vocational study for process control engineers and plant technicians
- Includes hidden switches to create faults for fault-finding training
- Fully programmable controllers with local and remote set points, and fully programmable proportional, integral and derivative control

TE37

CONTROL AND INSTRUMENTATION STUDY STATION

DESCRIPTION

The Control and Instrumentation Study Station uses industry-standard parts to teach industrial process control. It is an excellent tool to help train plant technicians and process control engineers.

Hot and cold water supplies connect to the study station. Two valves (worked by compressed air) control the flow of the water supplies into a process vessel. The process vessel has three jobs:

- A pressure vessel with a pressure-relief valve for safety
- A temperature-mixing chamber for the hot and cold water flows
- A liquid-level reservoir with a sight gauge

Transmitters on the pipework and process vessel send flow, level temperature and pressure signals to a patch panel. Other sockets on the patch panel connect to the valves and other instruments. The students use leads (included) with the patch panel to connect the instruments and valves for any particular experiment.

The two flow transmitters are differential pressure transmitters, connected across orifice meters. The hot flow transmitter normally connects to an orifice meter in the hot water inlet. A set of hand-operated two-way valves also allow it to connect to a third orifice meter in the drain pipe from the process vessel.

The study station includes two fully configurable controllers, each with remote or local set point inputs. The controllers are industry-standard, with a choice of different control methods, and fully adjustable proportional, integral and derivative (PID) circuits. Sockets on the patch panel connect to an electronic multi-channel recorder to log changes in process variables.

NOTE: The chart recorder is paperless, so you need a suitable computer and colour printer if you need to print out hard copies of the chart recorder traces.

For fault-finding practice, there is a set of hidden switches on the side of the study station. These switches break the electrical circuits from the transmitters, instruments and control valves.

STANDARD FEATURES

- Supplied with a comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Setting up process transmitters
- Level, pressure, flow and temperature control
- Cascade control
- Coupled and decoupled interactive control
- Ratio control
- Feedforward control
- Feedforward-feedback control
- Split range control
- Fault-finding

ESSENTIAL ANCILLARY

- Service Module (SM37) – This module connects to a suitable cold-water supply and outputs hot and cold water at the correct flow and pressure for the Study Station. It includes an air compressor and storage vessel to supply compressed air to the Study Station valves.

RECOMMENDED ANCILLARY

- Distributed Control System (TE37DCS) – Refer to separate datasheet

TE37

CONTROL AND INSTRUMENTATION STUDY STATION

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

NETT DIMENSIONS AND WEIGHT:

1850 mm x 1100 mm x 750 mm and 272 kg

PACKED DIMENSIONS AND WEIGHT:

Approximately 3.04 m³ and 544 kg

REFERENCE SIGNALS:

2 x adjustable reference signals, 4 to 20 mA

TRANSMITTERS (ALL USE INDUSTRY-STANDARD 4 TO 20 MA CURRENT LOOP):

- Pressure and temperature transmitters
- Level transmitter (by differential pressure)
- 2 x flow transmitters (by differential pressure at orifice meters). One flow transmitter connects to the hot water inlet or to the process vessel drain.

CONTROLLERS:

2 x electronic controllers with numeric displays. Remote or local set point and two outputs. Can be set for different control methods:

- Manual
- Proportional (P)
- Proportional and integral (PI)
- Proportional, integral and derivative control (PID)

PID values may be set by the user or found by the controller's automatic tune.

Local set point is at the keypad on the controller. Remote set point and all inputs and outputs are connected at the patch panel.

COMPUTING RELAYS:

2 x arithmetic units

Each unit has a multiplier (k) and accepts three inputs (A, B and C), to give an output of $B+k(A-C)$. All inputs and outputs are connected at the patch panel and operate with a 4 to 20 mA current signal.

VALVES:

2 x proportional valves

Pneumatically controlled by a positioner and a 4 to 20 mA current signal from the Patch Panel.

MULTICHANNEL RECORDER:

Six inputs (4 to 20 mA) connected at the patch panel

PROCESS VESSEL:

Cylindrical steel chamber with hot and cold inputs, outlet (drain) and overflow. Includes a 2 bar pressure-relief valve for safety and a transparent sight gauge to its front.

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

TE37: Single-phase, 230 V or 110 V (determined by order) 50/60 Hz, 250 W

TE37DCS (computer power): To customer's needs

SM37: Three-phase, 50/60 Hz, 415 V or 220 V (determined by order)

WATER SUPPLY NEEDED FOR THE TE37:

Hot water: 50°C, Nominal 5 L/min at 2 bar

Cold Water: Nominal 5 L/min at 2 bar

Drain: 10 L/min

WATER SUPPLY NEEDED FOR THE SM37:

Cold water at a Nominal 10 L/min and 1 bar

Drain: Nominal 5 L/min

AIR SUPPLY NEEDED FOR THE TE37:

Clean, dry compressed air at 2 bar and 0.07 m³/min

FLOOR SPACE NEEDED FOR THE TE37:

3 m x 2 m (to allow access)

ADDITIONAL SPACE NEEDED FOR THE SM37:

3 m x 2 m (to allow access)

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

-25°C to +55°C (when packed for transport).

OPERATING TEMPERATURE RANGE:

+5°C to +40°C (ambient)

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C.

SOUND LEVELS

TE37: Lower than 70 dB(A)

SM37: Greater than 80 dB(A). TecQuipment recommend that you wear ear protection if you work near to the Service Module.

TE3300/02

PRESSURE PROCESS TRAINING SYSTEM

A self-contained, mobile module using pressure as the control variable to illustrate the principles of single-loop control and the calibration and tuning of controllers, transmitters, converters and valves.



- Demonstrates automatic control of pressure in an accumulator using proportional, proportional plus integral, and proportional, integral plus derivative (PID) control
- Uses industrial-standard parts to make it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Compact, mobile and fully self-contained
- Connects to the TE3300/03 Flow Process Training System for cascade control
- Connects to the TE3300/06 Computer Control System for distributed control
- Safe, practical and realistic

TE3300/02

PRESSURE PROCESS TRAINING SYSTEM

DESCRIPTION

The Pressure Process Training System is a compact and mobile unit for a wide range of experiments in pressure control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can perform many experiments. By connecting this to other products in the TE3300 range further experiments are possible. For cascade control of flow and pressure, it can link to the optional Flow Process Training System (TE3300/03). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

The main parts of the Pressure Process Training system are:

- Industrial controller with auto-tune feature
- Two-channel chart recorder
- Current-to-pressure (IP) converter
- Gauge pressure transmitter
- Pneumatic control valve
- Pressure accumulator
- Three-speed pump
- Reservoir

To carry out experiments, students fill the reservoir with clean water and prime the system. They then set the controller to regulate the flow of water using a pneumatic valve. This alters the pressure in the accumulator. A pressure transmitter measures the accumulator pressure and gives feedback to the controller. For a realistic experience, the equipment has industrial-standard instrumentation and parts.

The apparatus includes two gate valves. One valve controls the flow at the output (drain) and the other acts as a flow-bypass valve. A chart recorder shows and logs the changes of the process variable (level) and the controller output.

NOTE: The chart recorder is paperless, so you need a suitable computer and colour printer if you need to print out hard copies of the chart recorder traces.

A socket on the side of the apparatus links to the Computer Control System (TE3300/06, available separately).

STANDARD FEATURES

- Supplied with comprehensive user guides
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Cascade control of flow and pressure (when used with the TE3300/03 Flow Process Training System)
- Distributed control (when used with the TE3300/06 Computer Control System)

ESSENTIAL ANCILLARIES

- Service Module (SM3300)* **OR**
- Stable supply of 0.5 litres/s of clean, dry, oil-free air at 2–10 bar

RECOMMENDED ANCILLARIES

- Flow Process Training System (TE3300/03)
- Computer Control System (TE3300/06)

ANCILLARY FOR

- Flow Process Training System (TE3300/03)

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

–25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB (A)

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

Single-phase 230 V at 0.3 A or 110 V at 0.6 A, 50/60 Hz (determined by order)

COMPRESSED AIR:

(see Essential Ancillaries)

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

DIMENSIONS AND WEIGHTS:

Nett: 700 mm x 800 mm x 1750 and 120 kg

Packed: Approximately 1 m³ and 150 kg

TE3300/03

FLOW PROCESS TRAINING SYSTEM

A self-contained, mobile module for flow process control experiments to illustrate the principles of single-loop control and the calibration and tuning of controllers, transmitters, converters and valves.



- Demonstrates automatic control of flow using proportional, proportional plus integral, and proportional, integral plus derivative (PID) control
- Uses industry-standard parts to make it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Compact, mobile and fully self-contained
- Connects to the TE3300/02 Pressure Process and TE3300/04 Level Process Training Systems for cascade control
- Connects to the TE3300/06 Computer Control System for distributed control
- Safe, practical and realistic

TE3300/03

FLOW PROCESS TRAINING SYSTEM

DESCRIPTION

The Flow Process Training System is a compact and mobile unit for a wide range of experiments in flow control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can perform many experiments. By connecting this to other products in the TE3300 range further experiments are possible. For cascade control of flow and pressure, it can link to the optional Pressure Process Training System (TE3300/02). For cascade control of flow and level, it can link to the optional Level Process Training System (TE3300/04). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

The main parts of the Flow Process Training System are:

- Industrial controller with auto-tune feature
- Two-channel chart recorder
- A gap-type (rotameter) flow meter
- Fixed orifice and pressure transmitter
- Pneumatic control valve
- Three-speed pump
- Reservoir

To carry out experiments, students fill the reservoir with clean water and prime the system. They then set the controller to regulate the flow of the water using a pneumatic valve. The gap-type flow meter gives a visual indication of flow. The fixed orifice and pressure transmitter give feedback to the controller. For a realistic experience, the equipment has industrial-standard instrumentation and parts.

The apparatus includes two gate valves. One valve controls the flow at the output (drain) and the other acts as a flow-bypass valve. A chart recorder shows and logs the changes of the process variable (level) and the controller output.

NOTE: The chart recorder is paperless, so you need a suitable computer and colour printer if you need to print out hard copies of the chart recorder traces.

A socket on the side of the apparatus links to the Computer Control System (TE3300/06, available separately).

STANDARD FEATURES

- Supplied with comprehensive user guides
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Calibration of an orifice flow meter with a differential pressure transmitter
- Quadratic flow laws and square root extraction
- Cascade control of pressure and flow, and level and flow (when used with the TE3300/02 and TE3300/04)
- Distributed control (when used with the TE3300/06 Computer Control System)

ESSENTIAL ANCILLARIES

- Service Module (SM3300)* **OR**
- Stable supply of 0.5 litres/s of clean, dry oil free air at 2–10 bar

RECOMMENDED ANCILLARIES

- Pressure Process Training System (TE3300/02)
- Level Process Training System (TE3300/04)
- Computer Control System (TE3300/06)

ANCILLARY FOR

- Pressure Process Training System (TE3300/02)
- Level Process Training System (TE3300/04)

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

–25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB (A)

TE3300/04

LEVEL PROCESS TRAINING SYSTEM

A self-contained, mobile module for level process control experiments to illustrate the principles of single-loop control and the calibration and tuning of controllers, transmitters, converters and valves.



- Demonstrates automatic control of level using proportional, proportional plus integral, and proportional, integral plus derivative (PID) control
- Uses industry-standard parts to make it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Compact, mobile and fully self-contained
- Connects to the TE3300/03 Flow Process Training System for cascade control
- Connects to the TE3300/06 Computer Control System for distributed control
- Safe, practical and realistic

TE3300/04

LEVEL PROCESS TRAINING SYSTEM

DESCRIPTION

The Level Process Training System is a compact and mobile unit for a wide range of experiments in flow control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can perform many experiments. By connecting this to other products in the TE3300 range further experiments are possible. For cascade control of flow and level, it can link to the optional Flow Process Training System (TE3300/03). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

The main parts of the Level Process Training system are:

- Industrial controller with auto-tune feature
- Two-channel chart recorder
- Current-to-pressure converter
- Differential pressure transmitter
- Transparent vessel
- Pneumatic control valve
- Three-speed pump
- Reservoir

To carry out experiments, students fill the reservoir with clean water and prime the system. They then set the controller to regulate the flow of water using a pneumatic valve. This alters the water level in the transparent vessel. The differential pressure transmitter connected to the vessel gives feedback to the controller. For a realistic experience, the equipment has industrial standard instrumentation and parts.

The apparatus includes two gate valves. One valve controls the flow at the output (drain) and the other acts as a flow-bypass valve. A chart recorder shows and logs the changes of the process variable (level) and the controller output.

NOTE: The chart recorder is paperless, so you need a suitable computer and colour printer if you need to print out hard copies of the chart recorder traces.

A socket on the side of the apparatus links to the Computer Control System (TE3300/06, available separately).

STANDARD FEATURES

- Supplied with comprehensive user guides
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Wet and dry leg operation of a differential pressure transmitter
- Operation of a level control system
- Cascade control of level and flow (when used with the TE3300/03 Flow Process Training System)
- Distributed control (when used with the TE3300/06 Computer Control System)

ESSENTIAL ANCILLARIES

- Service Module (SM3300)* **OR**
- Stable supply of 0.5 litres/s of clean, dry oil free air at 2–10 bar

RECOMMENDED ANCILLARIES

- Flow Process Training System (TE3300/03)
- Computer Control System (TE3300/06)

ANCILLARY FOR

- Flow Process Training System (TE3300/03)

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory environment

STORAGE TEMPERATURE RANGE:

–25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB (A)

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

Single-phase 230 V at 0.3 A or 110 V at 0.6 A, 50/60 Hz (determined by order)

COMPRESSED AIR:

See Essential Ancillaries

TE3300/05

TEMPERATURE PROCESS TRAINING SYSTEM

A self-contained mobile module for temperature process control experiments to illustrate the principles of single-loop control and the calibration and tuning of controllers, transmitters, converters and valves.



- Demonstrates automatic control of temperature using proportional, proportional plus integral, and proportional, integral plus derivative (PID) control
- Uses industry-standard parts to make it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of temperature transmitters and thermocouples
- Compact, mobile and fully self-contained
- Includes delay coil to mimic realistic time lag due to a process
- Connects to the TE3300/06 Computer Control System for distributed control
- Safe, practical and realistic

TE3300/05

TEMPERATURE PROCESS TRAINING SYSTEM

DESCRIPTION

The Temperature Process Training System is a compact and mobile unit for a wide range of experiments in temperature control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can perform many experiments, but it can also connect to the optional Computer Control System (TE3300/06) for distributed control.

The main parts of the Temperature Process Training system are:

- Industrial controller with autotune feature
- Two-channel chart recorder
- Heat-exchanger and fan
- Temperature transmitter
- Thermocouples
- Delay coil
- In-line heater
- Three-speed pump
- Reservoir

To carry out experiments, students fill the reservoir with clean water and prime the system. They then set the controller to regulate the power to the in-line heater and control the temperature of the water at any of three places. The heat-exchanger removes the heat from the water, to give quicker experiments. The thermocouples (selected by a three-way switch) give feedback to the controller. For a realistic experience, the equipment has industrial-standard instrumentation and parts.

The apparatus includes one gate valve that works as a flow bypass. A chart recorder shows and logs the changes of the process variable (temperature) and the controller output.

NOTE: The chart recorder is paperless, so you need a suitable computer and colour printer if you need to print out hard copies of the chart recorder traces.

A socket on the side of the apparatus links to the Computer Control System (TE3300/06, available separately).

STANDARD FEATURES

- Supplied with comprehensive user guides
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of temperature transmitters and thermocouples
- Operation of a temperature control system
- Distributed control (when used with the TE3300/06 Computer Control System)

RECOMMENDED ANCILLARIES

- Stopwatch (SW1)
- Thermocouple calibrator*
- One-litre container with accurate scale and accurate weighing machine (to measure water flow rate)*
- Computer Control System (TE3300/06)

* not supplied by TecQuipment

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

-25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB (A)

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

Single-phase 230 V at 3 A or 110 V at 7 A, 50/60 Hz (determined at order)

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

DIMENSIONS AND WEIGHTS:

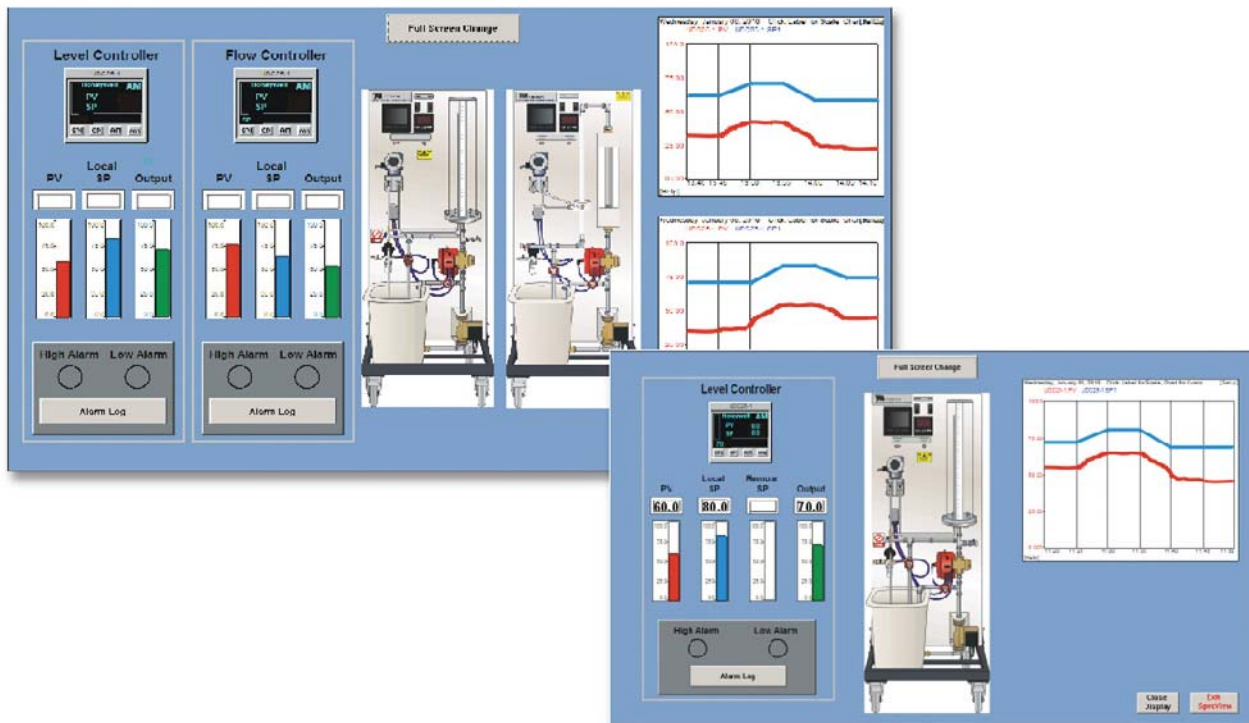
Nett: 700 mm x 800 mm x 1750 and 120 kg

Packed: Approximately 1 m³ and 150 kg

TE3300/06

COMPUTER CONTROL SYSTEM

Connects to the TE3300 Process Control modules for remote control and monitoring of processes (distributed control).



- Industry-standard software
- Colourful, easy-to-use on-screen mimics of the processes
- Includes high-specification computer, large monitor, keyboard and mouse
- Controls, monitors and logs all important process controller parameters
- Real-time displays of variables
- Live monitoring of process trends and alarms
- Ready-made applications – includes applications for use with TecQuipment's products

TE3300/06

COMPUTER CONTROL SYSTEM

DESCRIPTION

The Computer Control System (TE3300/06) is a computer control package for use with modules from TecQuipment's TE3300 Process Control range. It allows remote control and data acquisition from the controller of each process. This system will also control and collect data from the controllers of TE3300 modules when connected in cascade.

When used with the TE3300 Process Control range, computer control increases the student's experience of industry-standard process control.

The package includes a high-specification computer, with large screen monitor, keyboard and mouse. The package includes connections and cables for connection to the TE3300 modules. Supplied as standard on the computer is a suitable Microsoft® Windows® operating system.

The industry-standard control software includes applications specially written by TecQuipment for use with the TE3300 range. Just as in an industrial environment, the software applications mimic the variables measured by the controllers of each Process Control module. The user (operator) can easily see what happens at the remotely controlled process, as they adjust its performance.

The fully configurable software logs all data and any alarm conditions. The operator can also see the changing data in real time (as a trend) and log it for later examination. For ease of use, the software mimic (or graphical display window) and all data is in full colour.

STANDARD FEATURES

- Supplied with comprehensive user guides
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

When used with the TE3300 Process Control modules, computer control and monitoring of:

- Pressure process (TE3300/02)
- Flow process (TE3300/03)
- Level control process (TE3300/04)
- Temperature process (TE3300/05)
- Cascaded flow and pressure (TE3300/02 and TE3300/03)
- Cascaded flow and level (TE3300/03 and TE3300/04)

ANCILLARY FOR

One or more modules from the TE3300 Process Control range:

- Pressure Process Training System (TE3300/02)
- Flow Process Training System (TE3300/03)
- Level Process Training System (TE3300/04)
- Temperature Process Training System (TE3300/05)

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

Computer – specify supply at time of ordering

BENCH SPACE NEEDED:

Room for a computer, a mouse, a keyboard and a monitor

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

–25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

30% to 95% (non-condensing)

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

SOFTWARE:

Full colour, industry-standard supervisory control and data acquisition (SCADA)

WEIGHT:

Computer, keyboard, mouse and monitor, approximately 25 kg

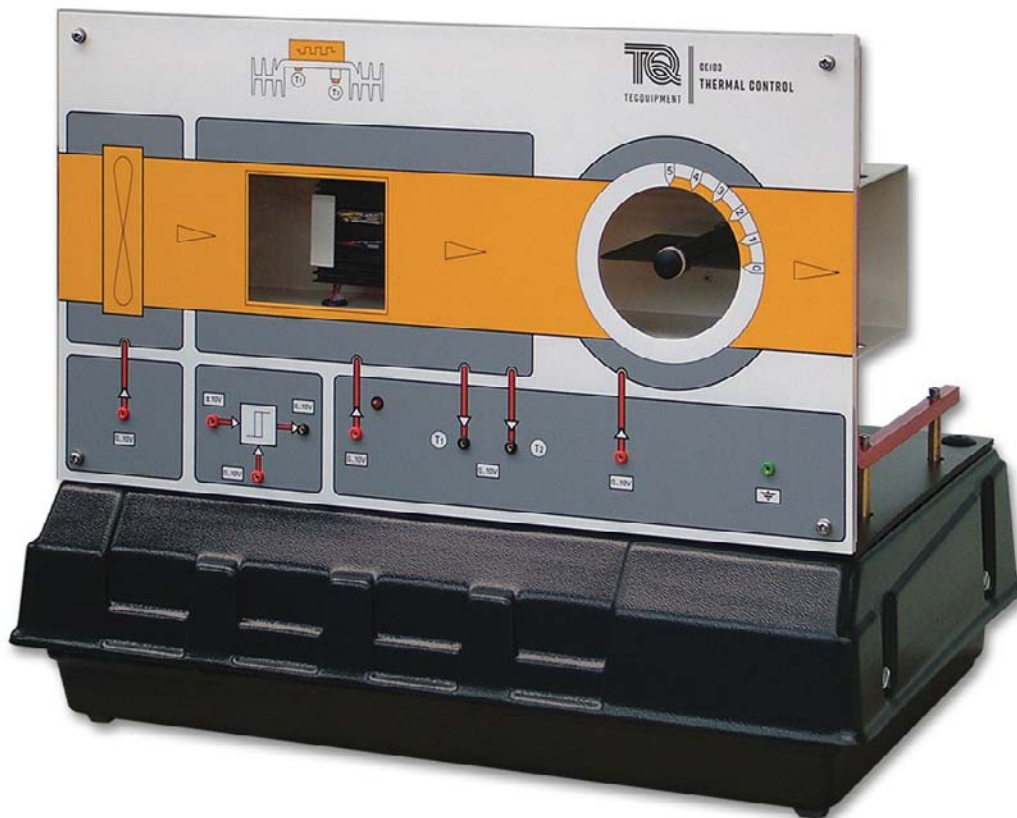
COMMUNICATIONS STANDARD:

Ethernet TCP/IP

CE103

THERMAL CONTROL PROCESS APPARATUS

A self-contained, bench-mounted apparatus to demonstrate basic and advanced principles of control of single and coupled tanks, including the study of static and dynamic systems.



- Self-contained and compact bench-mounting unit
- Electrically-heated and air-cooled model process that mimics a real industrial process
- Includes variable hysteresis for advanced process control experiments
- Temperature sensors with different thermal contact to the process give variations in thermal inertia and time constant
- Front panel includes mimic diagram of the process so students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers

CE103

THERMAL CONTROL PROCESS APPARATUS

DESCRIPTION

The Thermal Control Process Apparatus mimics a common industrial process, including an air-conditioning plant, where a combination of adjustments can control temperature. These can be:

- Varying the heat energy input to the system
- Varying the speed of a circulating fan
- Using a variable vane to restrict the flow

The apparatus has a variable-speed fan that forces air through a duct. In the duct is an electrically-heated process block. A balance of the heat gained from electrical heating and heat lost by convection and conduction gives a steady temperature at the block.

Two temperature sensors measure the temperature of the block. One sensor is in direct thermal contact with the block. The other sensor mounts on an insulating spacer to introduce thermal inertia and variable-time constants into the control loop. A servo-driven vane, mounted after the fan and the process block, creates a variable restriction downstream for more advanced experiments.

The control problem is to keep the process temperature within acceptable limits while it works under various conditions. A combination of regulating the electrical energy to the heater, varying the air flow rate and rotating the vane gives the heat control. The apparatus has scaled-down time constants for shorter laboratory time.

A relay amplifier with variable hysteresis allows more advanced experiments.

STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Heat transfer
- On/off control – experiment includes investigation of overshoot and undershoot, on and off time ratio, rates of heating and cooling, offset and hysteresis
- Proportional, proportional + integral, or proportional + integral + differential control
- Frequency response of model process
- Thermal inertia and variable-time constants
- Multi-variable control – up to three variables can be monitored and individually controlled

The flexible design of the equipment allows the user to develop many other analysis and control exercises to suit their needs. It is good for extended or advanced control experiments, and is ideal for student project work.

ESSENTIAL BASE UNIT

- Controller (CE120) – A controller with analogue and digital controls and instruments or
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) or
- Other suitable controller with ± 10 V inputs and outputs

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see separate datasheet) with editable, pre-made control experiments for use with the CE103.

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

240/110 VAC, 1 A, 50/60 Hz, with earth

Other voltages and frequencies available to special order

BENCH SPACE NEEDED:

1 m x 750 mm

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

-25°C to $+55^{\circ}\text{C}$ (when packed for transport)

OPERATING TEMPERATURE RANGE:

$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures $< 31^{\circ}\text{C}$ decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB(A)

CE105/CE105MV

COUPLED TANKS APPARATUS

A self-contained, bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of open and closed-loop control of flow rate and liquid level in single and dual tank systems.



KEY FEATURES

- Self-contained and compact bench-mounting unit that mimics a real industrial process
- Option for second pump with second flow meter to allow multivariable (MV) operation (CE105MV)
- Level control of one and two tanks
- Front panel includes mimic diagram of the process so students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- Includes rotameter-type flow meter so students can see the flow rate

CE105/CE105MV

COUPLED TANKS APPARATUS

DESCRIPTION

The Coupled Tanks Apparatus investigates basic and advanced control engineering principles. This includes the study of static and dynamic systems. It is also an ideal system to use with other control strategies such as fuzzy logic.

The CE105 shows fluid transport and liquid level control problems in process control.

The basic control problem is to regulate the liquid level in one of the tanks by varying the speed of the circulating pump. The user guide includes experiments that cover system modelling using static and transient measurements, steady-state error analysis, transient response studies and Ziegler/Nichols tuning methods.

Each tank has a level sensor that gives output signals proportional to the water level in each tank. A scale on each tank allows students to check the level-sensor calibration.

A variable-speed pump forces water into the left-hand tank. A valve connects this tank to a second tank, if needed, for two-tank experiments. A rotameter-type flow meter shows the flow rate. An electronic flow meter measures the flow rate.

The CE105MV Multivariable Coupled Tanks Apparatus gives extra experiments. It is similar to the CE105 but with a second pump and flow meter. This pump forces water into the right-hand tank and works independently of the other pump. This gives more advanced experiments into the principles of multivariable control (both pumps work together to give the correct levels in the two tanks simultaneously).

STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Calibration of transducer and actuator circuits
- System dynamics in process systems
- Design and operation of analogue proportional, proportional + integral, or proportional + integral + differential control controllers
- Steady-state errors and closed-loop transient responses
- Ziegler/Nichols controllers tuning rules
- Multivariable control
- Step-change tuning
- State feedback
- Flow control

The flexible design of the equipment allows the user to develop many other analysis and control exercises to suit their needs. It is good for extended or advanced control experiments, and is ideal for student project work.

ESSENTIAL BASE UNIT

- Controller (CE120) – A controller with analogue and digital controls and instruments or
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) or
- Other suitable controller with 10 V inputs and outputs

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see separate datasheet) with editable, pre-made control experiments for use with the CE105.

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

90 VAC to 250 VAC 0.4 A, 50/60 Hz, with earth

BENCH SPACE NEEDED:

1 m x 750 mm

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

–25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

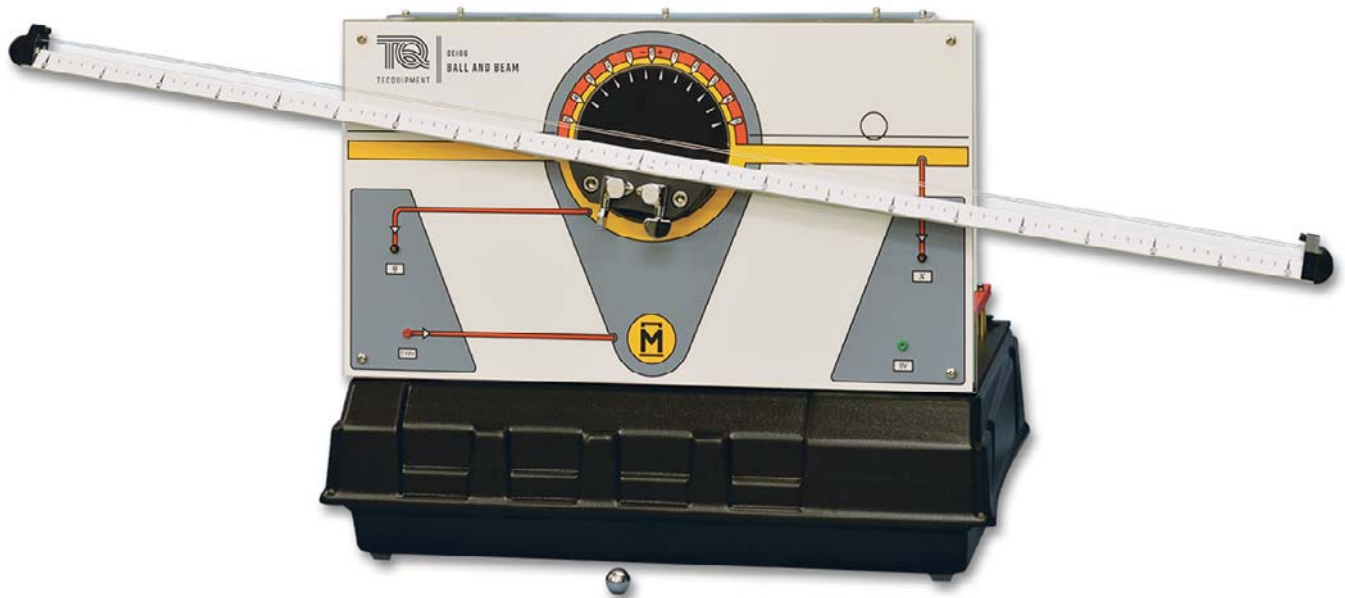
OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

CE106

BALL AND BEAM APPARATUS

A self-contained, bench-mounted apparatus to demonstrate basic and advanced principles of control in naturally unstable systems.



- Self-contained, compact and bench-mounting unit that mimics a real control problem in unstable systems, such as missile or rocket take-off
- Highly visual apparatus, with moving ball and front panel mimic diagram of the process – students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- For basic and advanced experiments with angle, velocity and position control

CE106

BALL AND BEAM APPARATUS

DESCRIPTION

The Ball and Beam Apparatus shows the control problems of unstable systems, for example a rocket or missile during launch, which needs active control to prevent the missile going unstable and toppling over.

The apparatus has a steel ball which is free to roll on two parallel tensioned wires positioned on a beam that pivots at its centre. A servo motor controls the beam angle and sensors measure the beam angle and ball position. The basic control problem is to vary the beam angle to control the ball position. The system is a double integrator, so it is naturally unstable. It needs active feedback control using phase-advance methods.

ESSENTIAL BASE UNIT

- Controller (CE120) – A controller with analogue and digital controls and instruments
- OR**
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included)
- OR**
- Other suitable controller with ± 10 V inputs and outputs

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software with editable, pre-made control experiments for use with the CE106.

STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

- Measurement of system dynamics by transient and closed-loop methods
- Design of analogue phase-advance compensators
- Design of state reconstructors to obtain estimates of ball velocity and position

The flexible design of the equipment allows the user to develop many other analysis and control exercises to suit their needs. It is good for extended or advanced control experiments, and is ideal for student project work.

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

90 VAC to 250 VAC, 0.4 A, 50/60 Hz, with earth

BENCH SPACE NEEDED:

1.5 m x 750 mm

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

-25°C to $+55^{\circ}\text{C}$ (when packed for transport)

OPERATING TEMPERATURE RANGE:

$+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures $< 31^{\circ}\text{C}$ decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB(A)

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

NETT DIMENSIONS AND WEIGHT:

1070 mm x 330 x 420 mm; 18 kg

PACKED DIMENSION AND WEIGHT:

0.64 m³, 52 kg (approx – packed for export)

INPUT (0 TO 10 VDC):

- Motor

OUTPUTS (0 TO ± 10 VDC):

- Ball position
- Beam angle

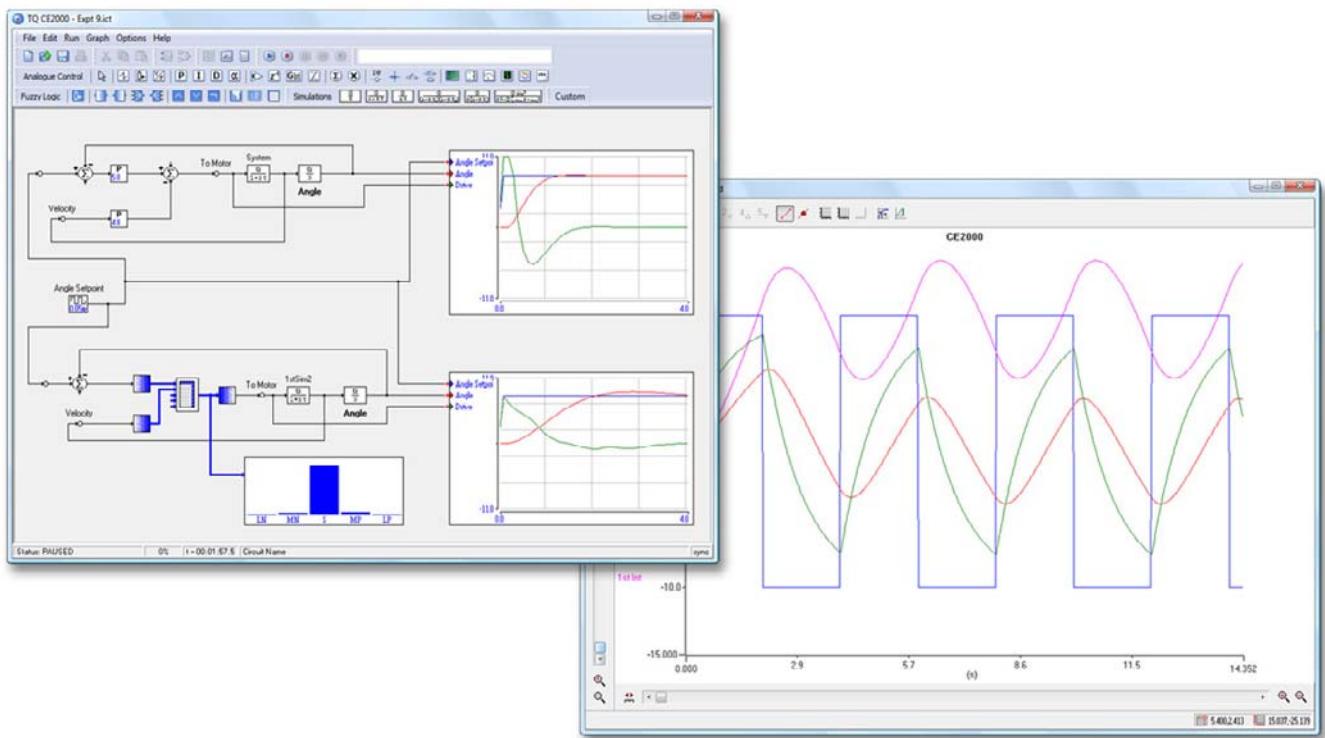
OTHER PARTS INCLUDED:

- Connecting cables
- Spare balls and wire
- Accessories for cleaning the wire

CE2000

CONTROL SOFTWARE

Icon-based software that simulates control systems and works with TecQuipment's Controller (CE120) or Digital Interface (CE122) to control and acquire data from TecQuipment's Control Engineering range.



- Software only – needs no extra circuit boards in the computer
- Easy-to-create control circuits made by linking together drag-and-drop icons
- Includes a range of ready-made fuzzy logic and control blocks, such as proportional, integral and derivative blocks
- Includes ready-made blocks that simulate first and second order systems
- Includes blocks that work as function generators, with a full range of output signals
- Real time display of variables by virtual meters, virtual chart recorders or virtual oscilloscopes
- Collected data can be shown and printed as a chart or exported for use in other programs
- Users can create their own circuits and save them, or use the ready-made circuits supplied

CE2000

CONTROL SOFTWARE

DESCRIPTION

The CE2000 is a powerful control software package with many features. It is supplied as standard with TecQuipment's Controller (CE120), Digital Interface (CE122) and Process Trainer (CE117). The software allows students and experienced control engineers to develop and test a wide selection of controllers and filters.

The Control Software combines controller design and implementation into one logical process. This reduces a student's learning difficulties and helps them to quickly understand and create a working control system.

Students use the software icons and wire them together on screen, just as they would draw a control system on a piece of paper. The icons include the important parts of controllers, signal generators, manually controlled signals and voltages, and virtual instruments.

The students set the software to record important variables. They can then plot the results in a chart and export the data for use in other programs.

With the CE2000 software students can create one or more types of controller and simulate the theoretical responses. They can then find the response with real systems, such as the products in TecQuipment's Control Engineering range.

The CE2000 software works with selected products in TecQuipment's Control Engineering range. These products give a wide selection of system responses, including linear and non-linear, stable and unstable, oscillatory and multivariable.

Included with the CE2000 software are files that match the experiments supplied with selected products in TecQuipment's Control Engineering range.

Because of its open and flexible structure, the CE2000 and TecQuipment's interface or controller may also model, simulate and run any other compatible system.

For real-time control and data acquisition you must use the software with TecQuipment's Controller (CE120) or Digital Interface (CE122). TecQuipment's Process Trainer (CE117) already contains a built-in interface.

STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

LEARNING OUTCOMES

SOFTWARE ONLY:

The CE2000 user guide shows students how to use the software and how to build and test common control systems, such as:

- Design and implementation of three-term controllers
- Design of controllers and filters

SOFTWARE AND HARDWARE:

When used with other products from TecQuipment's CE range:

- Thermal Control (CE103)
- Level Control (CE105)
- Ball and Beam Control (CE106)
- Engine Speed Control (CE107)
- Coupled Drives Control (CE108)
- Ball and Hoop Control (CE109)
- Servo Control (CE110)
- Flow, Level, Pressure and Temperature Control (CE117)

ESSENTIAL ANCILLARIES

(not supplied by TecQuipment)

- Suitable computer with a CD-ROM drive, 2 spare USB connections, 15 MB of RAM and Microsoft® Windows® 2000, XP, Vista or Windows 7 operating system.

You need one USB socket for the USB dongle supplied with the software. You need a second USB socket for real time control and data acquisition of signals with hardware, for example - TecQuipment's Controller (CE120), Digital Interface (CE122) or Process Trainer (CE117).

RECOMMENDED ANCILLARIES

Selected Products in TecQuipment's Control Engineering range, including:

- Thermal Control Process Apparatus (CE103)
- Coupled Tanks Apparatus (CE105/CE105MV)
- Ball and Beam Apparatus (CE106)
- Engine Speed Control Apparatus (CE107)
- Coupled Drives Apparatus (CE108)
- Ball and Hoop Apparatus (CE109)
- Servo Trainer (CE110)
- Process Trainer (CE117)

CE2000

CONTROL SOFTWARE

SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

SIMULATED SIGNALS:

- Signal generator – sinusoidal, sawtooth and square wave, with variable frequency, amplitude and offset.
- D.C. level – fully variable

VIRTUAL INSTRUMENTS:

- Digital meter
- Bargraph
- Analogue meter
- Oscilloscope
- Chart recorder

CONTROLLER BLOCKS:

- Proportional gain – fully variable
- Integral gain – fully variable
- Derivative (differential) gain – fully variable
- Phase advance

SIMULATION BLOCKS:

- Integer
- First order system
- Double integrator
- Second order system
- First order with integrator system
- Second order underdamped system

OTHER BLOCKS:

- Gain
- Voltage to frequency convertor
- Delay
- Discrete transfer
- Saturation
- Summing junction – three input
- Multiplier – three input
- Switch
- Relay

FUZZY LOGIC BLOCKS:

- Fuzzy Pot
- Fuzzifier
- Defuzzifier
- Fuzzy Multiplexer
- Fuzzy Demultiplexer
- Fuzzy AND
- Fuzzy OR
- Fuzzy NOT
- Fuzzy AND Table
- Fuzzy Combined Meter
- Fuzzy Single Meter

MULTI-FUNCTION PROCESS CONTROL TEACHING SYSTEM – PCT40

PCT SERIES: PROCESS CONTROL TECHNOLOGY



CAPABILITIES

PCT40 shown with optional
Process Vessel Accessory - PCT41

- > The basic PCT40 is used under computer control to demonstrate a variety of single control loops. It can be quickly reconfigured between processes, such as level control, temperature control, flow control and pressure control. The advanced software enables the student to change the control parameters, record results and analyse the results for the different configurations
- > The PCT41 expands on the capabilities of the PCT40, and offers a wider range of control loops and strategies, including remote setpoints, dual loops, and fluid property control (using conductivity). Again all of these are under software control
- > Other accessories are available, including a control console with commercial PID controller, plus a pH probe and a pneumatic valve for those wishing to implement specialised demonstrations
- > Large range of demonstrations - configurable by the end user
- > Computer control as standard
- > Computer generated loop disturbances for repeatability, enabling small variations in control parameters to be investigated
- > Flexible system, suitable for project work

The Armfield PCT40 provides a cost-effective way of teaching a wide range of process control techniques in a simple basic unit. More advanced aspects of process control can be addressed by adding optional extras to the basic system.





KEY FEATURES OF 50 SERIES

The Essentials of Process Control (EPC) range of products takes students through the fundamentals and principles of process control and progresses to give them a thorough grounding in the control of physical processes. Four independent process units demonstrate level, flow, temperature and pressure as the controlled variable.

The concepts of closed loop control, including on/off control, proportional control, proportional/integral and proportional/integral/derivative (PID) control can be explored and demonstrated. Some units also cover both time proportioning and analogue control of the same parameter.

Each process is supplied complete with software that allows it to be controlled using a Windows PC via a USB connection. The effect of making changes to the system or to the controller configuration can be quickly investigated by applying repeatable disturbances or step changes to the process. Comparison of the responses obtained with different control settings clearly demonstrates the need for correct matching of the controller to the system characteristics.

To demonstrate industrial control systems, two further controlling devices are available, a full function commercial PID controller with autotune, and a programmable logic controller (PLC). The PLC has the control algorithms implemented in ladder logic and so are fully accessible to the user.

Another fundamental aspect of process control is an understanding of sensors and how they are calibrated. This is demonstrated by a sensor calibration apparatus designed specifically to demonstrate this subject.

- > Open Loop and Closed loop processes
- > On/off control (Fixed Dead Band)
- > P, PI and PID control
- > Underdamping and overdamping
- > Time proportioning control
- > Onset of instability
- > Manual loop tuning
- > Effect of filtering on sensor outputs
- > Commercial PID controllers
- > Autotuning
- > Ladder Logic controllers
- > Effect of Sample Time and Cycle Time
- > Sensor Calibration
- > Sensor electrical characteristics



PCT50 LEVEL CONTROL



Essentials of Process Control - Level Control - PCT50

PCT50 is a highly visible and easy to understand water level control process. It comprises two clear acrylic tanks; a process tank mounted above a sump tank. Water is pumped up to the process tank and drains back to the sump tank via two valves, one manually variable and the other switched by software. Each valve can also be fitted with different sized external orifices to change their characteristics.

This flexible arrangement allows a wide range of control scenarios to be set up, including two fundamentally different processes, i.e.:

Level control by proportionally varying pump speed (Inflow control)

Level control by time-proportioned opening of a solenoid valve (Outflow control)

When using inflow control, repeatable disturbances can be implemented using the solenoid valve, and varied by using different orifice sizes. When using outflow control the pump speed can be stepped to provide a full range of repeatable disturbances. These techniques allow direct comparison of different controller settings.

PCT51 FLOW CONTROL

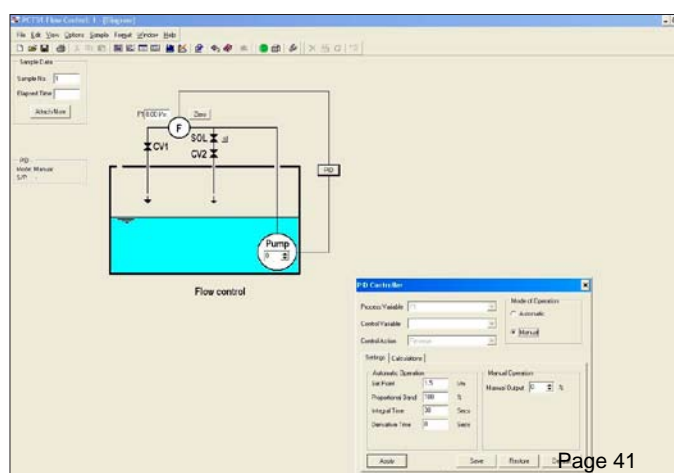


Essentials of Process Control - Flow Control - PCT51

PCT51 is a visible and easy to understand water flow control process. Water stored in the sump tank is pumped through a parallel pipe arrangement mounted on the lid of the tank and returns to the tank via two outlets, a software switched divert valve prior to the flowmeter and a manually operated variable valve after the flowmeter. Both outlets also incorporate interchangeable orifices to vary their characteristics.

The PCT51 demonstrates flow control by varying pump speed. Repeatable disturbances can be implemented using the solenoid valve and a wide range of different control investigations can be implemented using the interchangeable orifices and adjustable valves.

The PCT51 is an ideal system for demonstrating the onset of instability, the importance of filtering on the sensor output, and the trade-off between filter weighting and proportional gain on stability.



Process diagram for PCT51 (flow control by varying pump speed)

PCT52 TEMPERATURE CONTROL



Essentials of Process Control - Temperature Control - PCT52

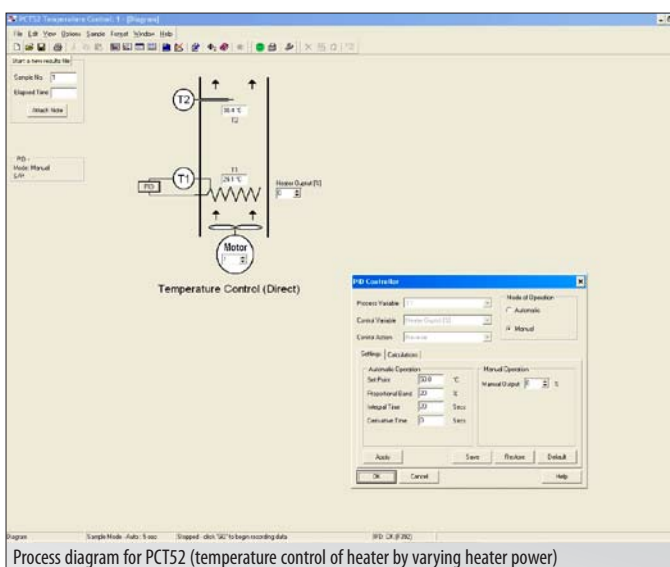
PCT52 is a visible and easy to understand temperature control process.

A fan blows air over a heater with radial fins and through a vertical clear acrylic duct. Sensors measure the surface temperature of the heater and the air temperature in the duct. This allows two different control implementations to be demonstrated with very different parameters, i.e.:

*Temperature control of the heater surface
(Direct Heating)*

Temperature control of the air (Indirect Heating)

In each case the temperature is controlled by varying the heater power and repeatable disturbances implemented by switching the fan speed, hence allowing direct comparison of different controller settings.



Process diagram for PCT52 (temperature control of heater by varying heater power)

PCT53 PRESSURE CONTROL



Essentials of Process Control - Pressure Control - PCT53

PCT53 is a highly visible and easy to understand pressure control process, which uses pumped water to generate air pressure in a closed tank.

It comprises two clear acrylic vessels, an upper process vessel mounted above an open sump tank. The process vessel is sealed and so the air inside the tank is pressurised as water from the sump tank is pumped into it. Water drains from the process tank back into the lower sump tank via two outlets, one continuous and one incorporating a remotely controlled solenoid valve. Both outlets incorporate interchangeable orifices plus a hand operated variable valve, allowing the flow of water to be varied continuously to suit particular demonstrations.

This flexible arrangement allows a wide range of control scenarios to be set up, including two fundamentally different processes, i.e.

Pressure control by proportionally varying pump speed (Inflow control)

Pressure control by time-proportioned opening of a solenoid valve (Outflow control)

When using inflow control, repeatable disturbances can be implemented using the solenoid valve, and varied by using the different orifice sizes.

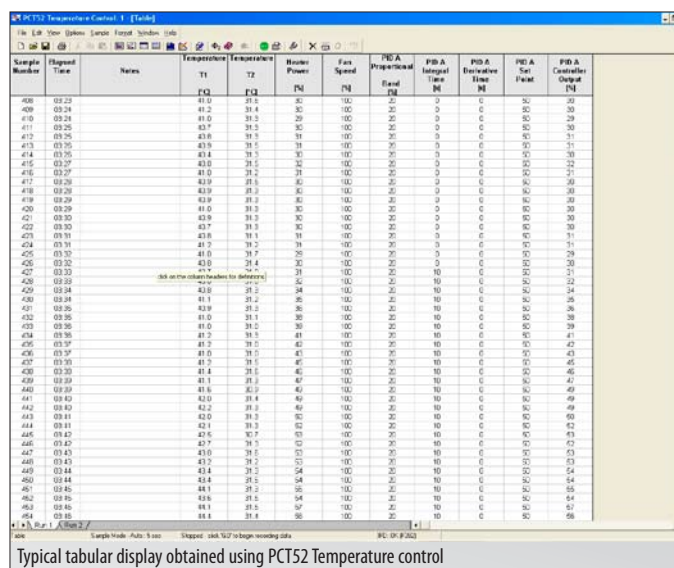
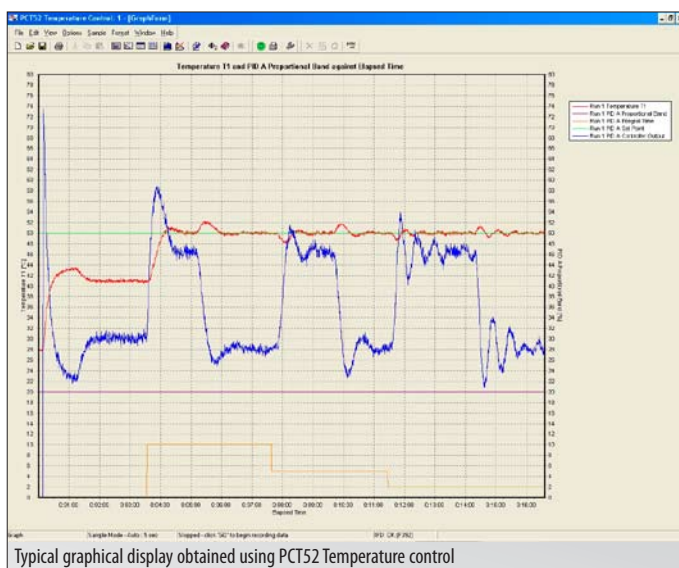
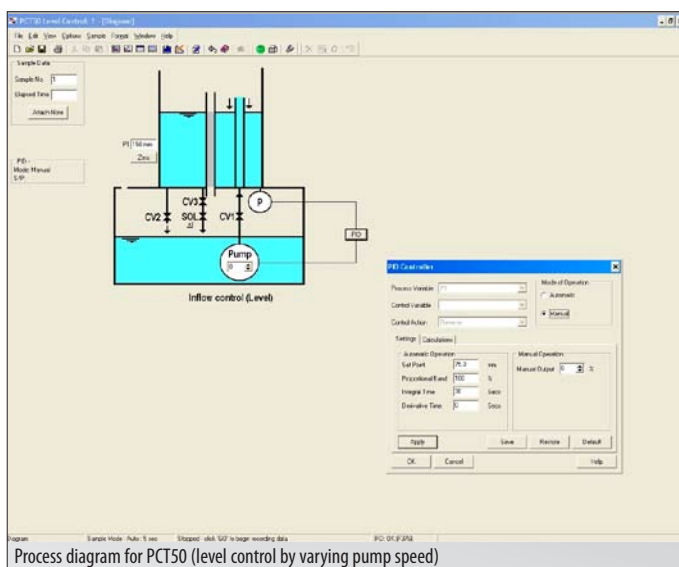
When using outflow control the pump speed can be stepped to provide a full range of repeatable disturbances. These techniques allow direct comparison of different controller settings

SOFTWARE AND INTERFACING TO THE PROCESS UNITS

Each process unit is supplied with computer software and interfaces to a Windows PC (not supplied) via a USB connection. The software controls the process units and allows all the demonstrations to be performed. It also provides powerful data collection, graph plotting, and analysis features.

However the process units can also be controlled from external devices, such as the Armfield PCT54 or PCT55 as described below. This is implemented by simple plug in terminal connections and instrument leads. When using an external controller the powerful datalogging and analysis tools of the Armfield software can still be used to display and save the results.

Similarly users can write their own PC control programs using tools such as LabView, and interface to the process units using the USB interface.



PCT54 INDUSTRIAL PID CONTROLLER



Essentials of Process Control - Industrial PID Controller - PCT54

PCT 54 is an industrial PID controller incorporated in a console with input and output connections and controls on the front panel, designed primarily for use with the Armfield EPC series of process control products but suitable for use as a general purpose PID controller. It is supplied preconfigured for proportional analogue PID control but can be reconfigured to give time proportioned control using a digital output. The user has full access to the configuration of the controller menus via the buttons on the front or using a USB connection to a PC.

An additional analog output and digital switch allow an uncontrolled device on the process, such as a water pump or solenoid valve, to be operated remotely allowing disturbances to be applied to the process.

PCT55 PROGRAMMABLE LOGIC CONTROLLER



Essentials of Process Control - Programmable Logic Controller - PCT55 (with PID algorithm)

PCT 55 is a programmable logic controller (PLC) with graphical touch screen control panel designed primarily for use with the Armfield EPC series of process control products, but can also be used to control other items.

It is supplied with PID control algorithms implemented in ladder logic and configured to suit each of the EPC processes. The user has full access to all the software and algorithms with the following features:

Calibration of the sensors associated with each product, calibration values can be stored in the PLC

Specific control exercises written for the four Armfield process units

Both proportional analogue and time proportioning discrete outputs

Individual Control of P, I & D parameters, reverting to default parameters for each product on start up

User selection of sample time, cycle time, filter weighting

The control algorithms are written as separate sub-routines, making it straightforward for advanced users to write and use their own ladder logic control algorithms

Control facilities exist for a user defined process as well as the four Armfield process rigs without having to change the programming

Freely available programming software for the PLC and touch screen downloadable from the manufacturer's website.

PCT56 SENSOR CONDITIONING AND CALIBRATION TRAINER



PCT56 is a trainer designed to introduce the essentials of signal conditioning applicable to process measurement sensors. It comprises an electronic console with inputs for sensors with three different types of electrical output, voltage current and resistance. The resistance input can be configured as 2 terminal or a 4 terminal bridge drive.

Controls on the console allow for ranging, fine scaling and offsetting of the measured values, the output being displayed on a 3.5 digit LCD display. Terminals allow the voltages to be monitored at each stage (voltmeter required). Thus many different sensors with different electrical outputs can be investigated and calibrated on this equipment.

For training purposes, the PCT56 is supplied with three pressure sensors of the same range, but different electrical outputs, plus a simple pressure vessel which can be pressurized using a hand pump.

The pressure vessel also incorporates a fitting for a reference instrument, such as the Armfield H12-8 digital pressure meter. The calibration vessel is fitted with a direct reading Bourdon gauge to give continuous indication of pressure inside the vessel for safety purposes.

ORDERING SPECIFICATIONS

PCT50 LEVEL CONTROL PROCESS

A level control process trainer, comprising:

- 4.25 litre Process tank, with overflow, mounted above 8 litre sump tank
- Level sensor range 0-150mm H₂O
- Two discharge ports, one with remote controlled solenoid valve and one with manually controlled valve.
- Four interchangeable orifices for use with the discharge valves
- Variable speed submersible centrifugal pump
- Capable of both analogue PID control using the pump and time proportioning PID control using the solenoid valve
- USB interface to PC, plus connection terminals for interfacing to external controllers
- Supplied with educational software for PID control as well as data logging.

PCT51 FLOW CONTROL PROCESS

A flow control process trainer, comprising:

- 0-4l/min flowmeter, mounted above 8 litre sump tank
- Two discharge ports, one with remote controlled solenoid valve and one with manually controlled valve.
- Four interchangeable orifices for use with the discharge valves
- Variable speed submersible centrifugal pump
- USB interface to PC, plus connection terminals for interfacing to external controllers
- Supplied with educational software for PID control as well as data logging.

PCT52 TEMPERATURE CONTROL PROCESS

A temperature control process trainer, comprising:

- 50W nominal heater mounted in a 60mm diameter duct
- Remotely switchable two speed fan blowing air over the heater
- Two platinum resistance temperature sensors, 0-150°C range, one measuring the heater surface temperature and one measuring the air temperature
- Capable of demonstrating control of both the heater surface or the air temperature
- Capable of demonstrating the difference between fast reacting and slow reacting sensors
- USB interface to PC, plus connection terminals for interfacing to external controllers
- Supplied with educational software for PID control as well as data logging.

PCT53 PRESSURE CONTROL PROCESS

A pressure control process trainer, comprising:

- 2 litre Process tank, mounted above a 3.5 litre sump tank
- 0-1 bar pressure range
- Two discharge ports, one with remote controlled solenoid valve and one with manually controlled valve.
- Four interchangeable orifices for use with the discharge valves

- Variable speed submersible centrifugal pump used to pressurise the air by water pressure.
- Capable of both analogue PID control using the pump and time proportioning PID control using the solenoid valve
- USB interface to PC, plus connection terminals for interfacing to external controllers
- Supplied with educational software for PID control as well as data logging.

PCT54 INDUSTRIAL PID CONTROLLER

An industrial PID controller in an electrical enclosure

- Includes manual controls to apply step changes to the process loops
- Can be set up by computer, using a USB interface.
- Autotune capability
- Analogue or time proportioning digital outputs
- Connects to the process under evaluation using simple plug connections:

1 Analogue input, 0-5V (from sensor)

2 Analogue outputs, 0-5V, (one from controller, one from manual control)

2 Digital outputs (one from controller, one from manual switch)

PCT55 PROGRAMMABLE LOGIC CONTROLLER

A programmable logic controller (PLC) with a touch screen control panel mounted in an electrical enclosure.

- Supplied pre-programmed with specific control exercises for the four Armfield EPC processes
- Proportional analogue and time proportioning discrete PID outputs
- Freely accessible programming software from plc manufacturer for both plc and touch screen
- USB interface to PC for monitoring and programming
- Users can access and modify the ladder logic control algorithms
- Connects to the process under evaluation using simple plug connections:

2 analogue inputs, 0-5V (from sensors), one analogue output and one digital output

- Additional terminals implemented on the front panel for user programming:

1 analogue output, 1 digital output and 2 digital inputs.

PCT56 SENSOR CONDITIONING AND CALIBRATION TRAINER

An electronic console and accompanying calibration vessel designed to demonstrate the principles of signal conditioning applicable to sensors used in process measurement.

- Voltage input ranges from 0-50mV to 0-5V
- Current inputs, 0-20mA, 4-20ma
- Scalable resistance and bridge circuit input
- Gain and offset adjustment controls
- Supplied with three 0-1 bar pressure sensors, one voltage output, one current output and one resistance output
- Includes pressure vessel and hand air pump to generate test pressures for the sensors

SENSORS AND TRANSDUCERS TRAINER



DL 2312HG

This sensors and transducers trainer teaches the operating principles of the sensors/transducers which are most widely used in industry. It is subdivided in two sections: in the lower section there are all the input and output transducers, while in the upper side there are all the signal conditioning systems as well as the instrumentation.

With this system, the student will be able to study the following:

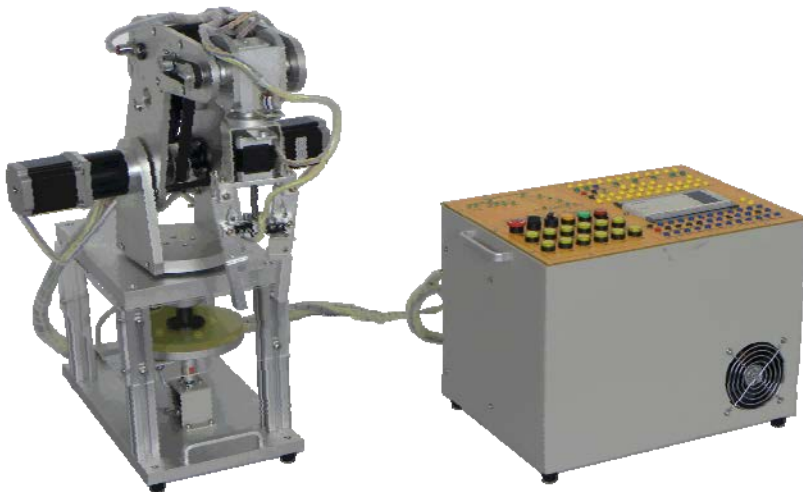
- Survey on the features of a position control system
- Features of a speed control system
- Application of the timer/counter as time meter
- Application of the timer/counter as tachometer or frequency meter
- Features of a visualization unit with graphic LED bar
- Features of a meter with mobile coil
- The buffer as compensator of the load effect of an output voltage in the potentiometer
- Servo-potentiometer. Variation of the output voltage on the basis of its position
- Resistance measurement through a Wheatstone bridge
- Voltage measurement through null balance (two methods)
- Temperature features through integrated circuit LM 35
- Features of: a platinum transducer with resistor on the basis of temperature (RTD), a thermistor N.T.C., a thermistor using an alarm circuit (double thermistor), a thermocouple type "K", a photovoltaic cell, a phototransistor, a detector of light intensity, a variable resistor, a flux meter, a pressure detector, an optoelectronic transducer with application for counting and speed measurement, a reflective opto transducer and the grey code disk, an inductive transducer, a Hall effect transducer, a tacho generator with dc permanent magnet, a dynamic microphone, an ultrasonic receptor, a loudspeaker coil, a buzzer, a dc solenoid, a dc relay, a permanent magnet motor, a dc current amplifier, a current amplifier and buffer amplifier application, a power amplifier and buffer, a differential amplifier, a V/I converter, a I/V converter, a V/F converter, a F/V converter, a full wave rectifier, a comparator, an alarm oscillator circuit, an electronic switch, an adder amplifier, an integrator amplifier, a differential amplifier, a Sample and Hold circuit, a humidity sensor.

THE TRAINER INCLUDES THE FOLLOWING INPUT SENSORS/TRANSDUCERS: linear slide potentiometer, rotary potentiometer, precision servo potentiometer, Wheatstone bridge circuit, thermistors NTC, RTD platinum sensor, IC temperature sensor, thermocouple, phototransistor, PIN photodiode, photoconductive cell, photovoltaic cell, LVDT, extensimetric transducer, linear position sensor, air flow sensor, air pressure sensor, humidity sensor, opto-electronic sensor, opto-reflecting sensor, inductive sensor, Hall effect sensor, dc tacho generator, microphone;

THE FOLLOWING OUTPUT SENSORS/TRANSDUCERS: electric resistance, incandescent lamp, buzzer, moving coil loudspeaker, ultrasonic transmitter, ultrasonic receiver, dc solenoid, dc relay, dc motor;

AND THE FOLLOWING SIGNAL CONDITIONING COMPONENTS: timer/counter, bar graphs, dc voltmeter, dc amplifiers, ac amplifiers, power amplifiers, current amplifiers, buffer amplifier, inverting amplifier, differential amplifier, V/F converter, F/V converter, I/V converter, V/I converter, complete wave rectifier, hysteresis switchable comparator, alarm oscillator, electronic switch, oscillator, filter, switchable low-pass filter, power supply, adding amplifier, integrator with switchable time constant, instrumentation amplifier, sample & hold circuit, gain and off set control amplifier.

ELECTRIC 6-AXIS MANIPULATOR



DL ROBSIX

This trainer simulates the operation of an industrial robot, such as: overall rotation, arm rotation, forearm rotation, wrist rotation, gripper rotation, gripper opening/closing.

It integrates different technologies, such as belt drive transmission technology, stepper motor driving, position detection, PLC and microprocessor technology.

The trainer can be controlled by MCU and PLC.

TRAINING OBJECTIVES

This model is mainly used for teaching, demonstration, experiments, practical training, curriculum design and scientific research. It can train the students to know the mechanical structure and drive, to design and debug both hardware and software of the electrical control system, to analyze and solve the problems that occur in the actual operation process.

The electric manipulator is a typical product of the electromechanical integration technology. Its design and application has a very important meaning in mechatronics, automation, information technology, etc.

TECHNICAL FEATURES

- Power supply: 220V \pm 10%, 50Hz
- Angles/distance range:
 - Manipulator rotation angle: 180°
 - Upper arm rotation angle: 90°
 - Forearm rotation angle: 90°
 - Wrist rotation angle: 90°
 - Gripper rotation angle: 180°
 - Gripper opening and closing: 0-40 mm.
- PLC: AB 2080-LC30-48QVB
- Stepper motors and drivers.
- Panel with buttons and PLC interface.
- Microprocessor control board with USB interface.
- PLC program and Microprocessor program

Complete with programming software in CD and manuals.

Dimensions:

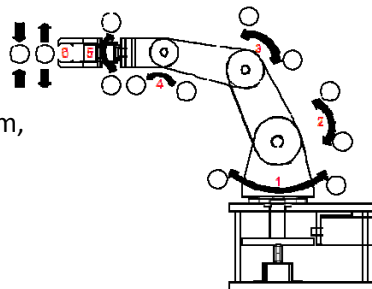
Base size : 380x200mm,

total height : 950mm

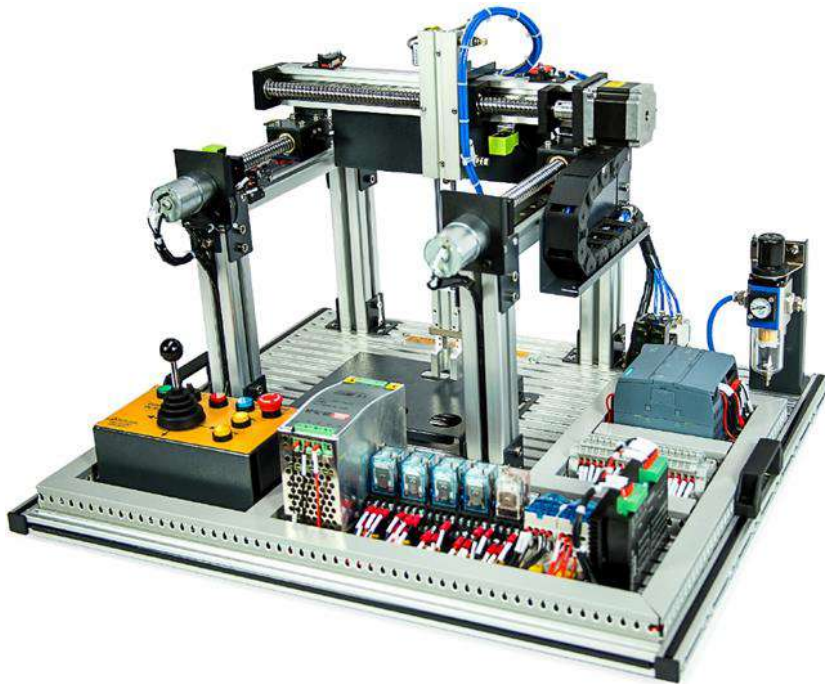
Weight: 27.5 kg.

Stepper motor: 6

Max load: 300g



TWO AXIS CARTESIAN ROBOT



Programmable multifunctional controller developed for simulating a Cartesian robot used in industrial environment.

This robot applies the modern mechanical technology, of pneumatics and sensors to allow the student to acquire notions in terms of mechanical design and tracking position technology. By means of a modern PLC, it is possible to set the system, in this way the student has the opportunity to interact with the world of the automation.

Technical specifications:

- The Cartesian robot is complete of the following components:
 - A supporting frame made of aluminium for components and devices composing the system
 - Control panel used to manage the system, composed of different switches and a switch to variate the robot position
 - Programmable PLC
 - Two-axis mechanism complete with motors and sensors for tracking position

components necessary for its operation

- Complete with processing software
- Compressed air system needed for the correct operation of the system
- Power supply: 100÷240 VAC 50/60 Hz

Training objectives:

This equipment allows carrying the following experiments:

- Study of the two-axis mechanism with torque ball screws
- Study and operation of position sensors
- Knowledge of the operating principle of pneumatic components
- Introduction to the control system
- Control of the stepper motor

Order reference code:

It is possible to order this product with two different codes. The code's choice is based on the PLC type to be included with the robot.

DL ROB2X-AB – Robot with PLC Alan Bradley

DL ROB2X-1200 – Robot with PLC Siemens

Basic manipulator– ROBOT



TRAINING OBJECTIVES

Basic manipulator developed for teaching, demonstration, practical training and planning according to the mechatronic, automation and information technology principles.

Through this product, it is possible to understand the mechanical structure of the robots used in the industrial sectors, to design and execute debugging procedures for the control of the system and to analyze and solve problems that occur in an actual operating process.

Based on the order code, it is possible to change the control unit choosing between a microcontroller or a PLC.

TECHNICAL SPECIFICATIONS

- 6-axis connection controlled by MIC
- 3-axis connection controlled by PLC
- Servo driven axis, long term
- Position accuracy: 0.1 degree
- Power supply: single-phase by network
- Axes range:
 - 1° axis: 180°
 - 2° axis: 180°
 - 3° axis: 145°
 - 4° axis: 180°
 - 5° axis: 180°
 - 6° axis: Adjustment of the clamp
- Work range: 400mm
- Max. speed per axis: 180 degrees/s
- Max. load: 250 g

ORDER CODE

- **DL ROBOT-PLC**
(controlled by PLC)
 - PLC - 2080-LC30-48QVB: 28DI, 20DO, 3PTO
 - Manual control panel
- **DL ROBOT-MIC**
(controlled by microcontroller)
 - ARM Cortex: M3, 8DI, 8DO, 6PTO
 - Manual control panel

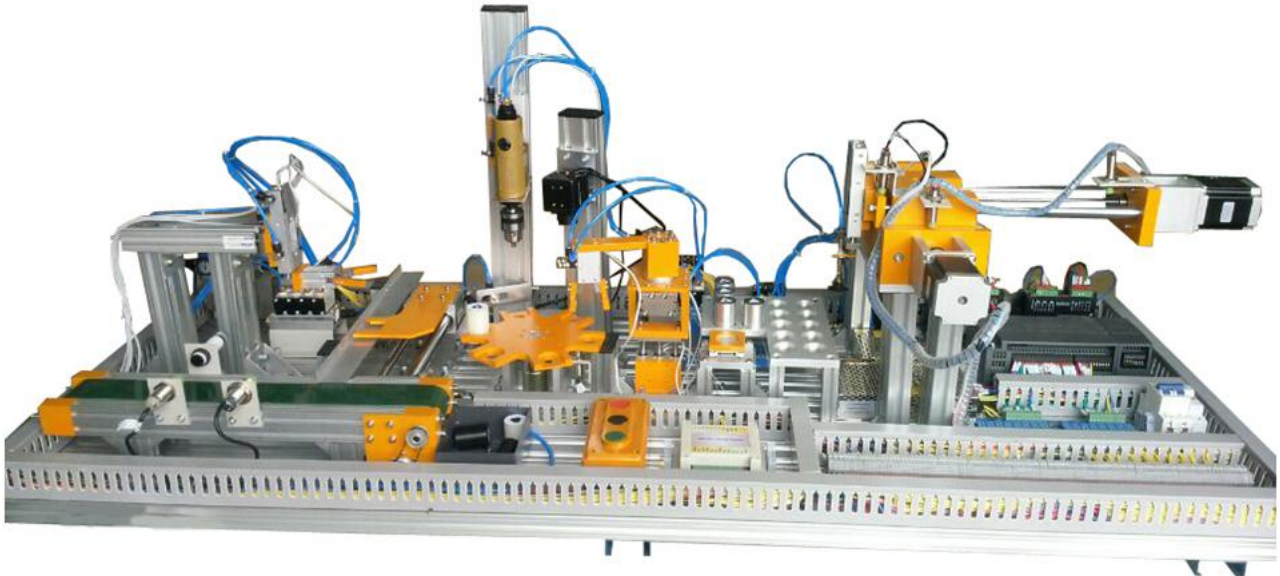
EXPERIMENTS

- Software programming–learning
- Single axis control
- 6-axes combined control (MIC)
- 3-axes combined control (PLC)
- Building blocks
- Soldering simulation

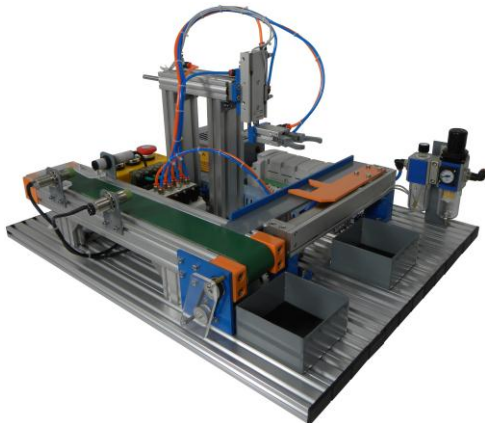
CIM – Computer Integrated Manufacturing

CIM IN BASIC CONFIGURATION
CIM IN ADVANCED CONFIGURATION
CIM IN COMPLETE CONFIGURATION

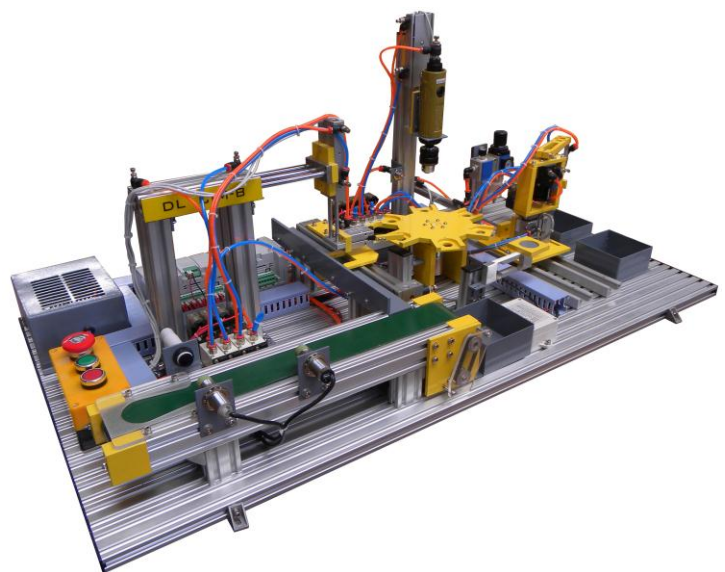
DL CIM-A
DL CIM-B
DL CIM-C



DL CIM-C



DL CIM-A



DL CIM-B

NOTE: A single-phase electro-compressor like the **DL 8110SLZ** is needed.

Computer-Integrated Manufacturing (CIM) is a method of manufacturing in which the entire production process is controlled by computer. Typically, it relies on closed-loop control processes, based on real-time input from sensors.

De Lorenzo's proposal for CIM automation products is especially designed for engineering graduates. Students can study the theory and work with the system to get a sound knowledge of the CIM, which allows for transversal applications in the following didactic areas: Automation, Pneumatics, Mechatronics, Electronics, Process Control, etc.

Our system is composed of different modules, each one reproducing a single basic application that is commonly used in the industry.

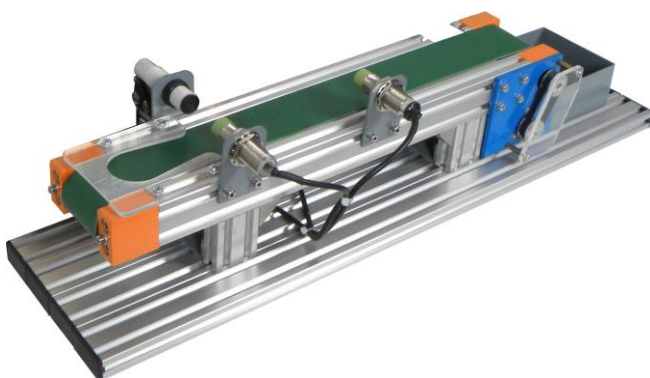
Each module is implemented with real electronics, mechanics and pneumatics components and has a specific function. As an integrated computer system, the output of one activity serves as the input to the next activity, through the chain of events. The whole system is controlled by one Programmable Logic Controller (PLC) and it can be configured to perform a complete process.

The basic modules are the following:

- Conveyor Unit
- Linear Transfer Unit
- Pick and Place Unit
- Six Station Rotary Table
- Vision Inspection System
- Drilling Module
- Unloading Arm
- Weighing Module
- Palletizer Unit

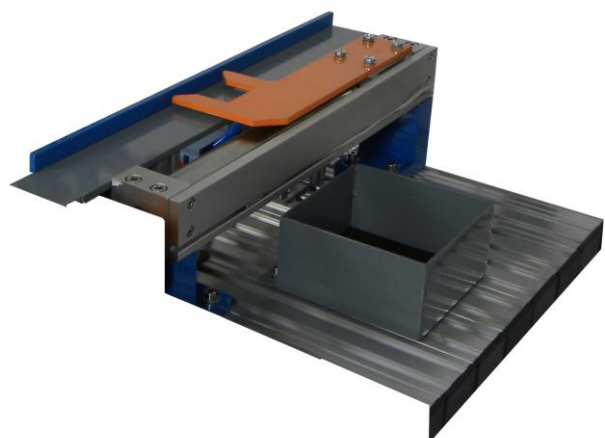
UNIT	DL CIM-A	DL CIM-B	DL CIM-C
Conveyor Unit	X	X	X
Linear Transfer Unit	X	X	X
Pick and Place Unit	X	X	X
Six Station Rotary Table		X	X
Drilling Module		X	X
Vision Inspection System			X
Unloading Arm		X	X
Weighing Module		X	X
Palletizer Unit			X

CONVEYOR UNIT



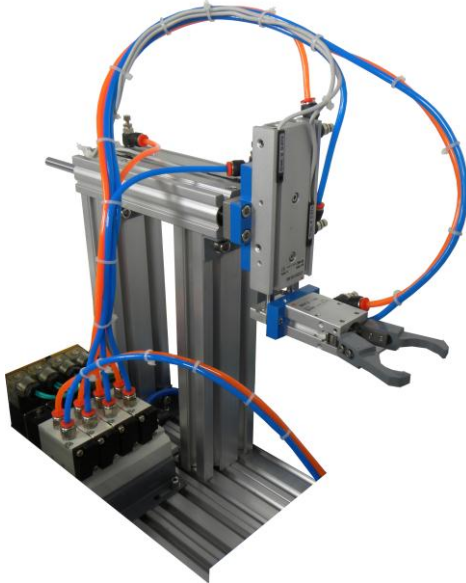
The materials are transferred in a linear motion by means of the belt conveyor driven by geared DC motors. This unit moves materials / objects from one end to the other. Sensors are used to sense the parts material and presence. This is a miniature model of a real industrial conveyor system.

LINEAR TRANSFER UNIT



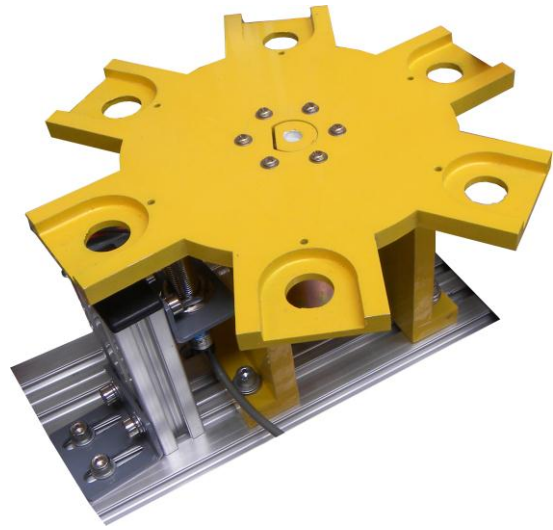
The Linear Transfer Unit is an electro-pneumatic controlled linear actuator. Magnetic switches are fixed to sense the retracted and extended position of the transfer unit. The Linear Transfer Unit transfers materials from the conveyor to the linear Pick and Place Unit with the help of a pneumatically operated rod less double acting cylinder.

PICK & PLACE UNIT



The Pick & Place Unit is a totally electro-pneumatic control system. There are three main parts in this unit: a Vertical arm (vertical double acting cylinder), a Horizontal arm (horizontal double acting cylinder) and an Angular gripper (double acting angular gripper for holding work pieces). Magnetic switches are fixed to sense the retracted and extended position of the actuator. The Pick & Place Unit transfers the material from the Linear Transfer Unit end to the next Unit with the help of vertical arm, horizontal arm and angular gripper.

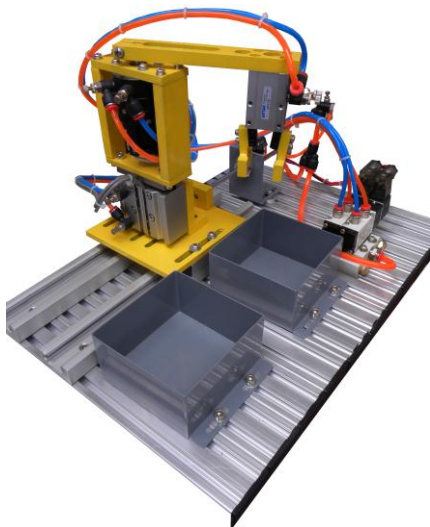
SIX STATION ROTARY TABLE



A Six Station Rotary Table consists of a horizontal circular worktable, on which the work piece is placed to be processed.

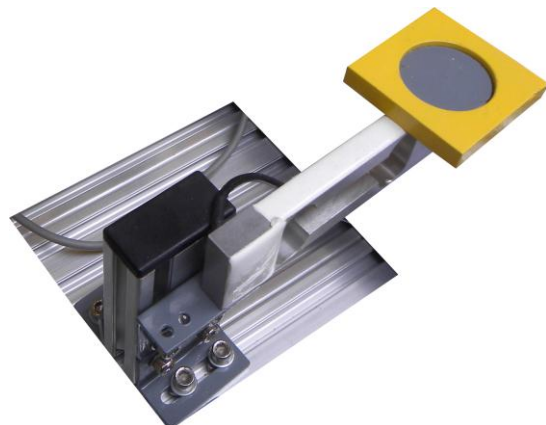
The worktable is indexed to present each work piece to each work head to accomplish the sequence of machining operations.

UNLOADING ARM



The Unloading arm or horizontal Pick & Place Unit is an electro-pneumatic system in which the movement is controlled by a linear and rotary actuator. This system works as a miniature pick and place robot with a limited path application. The Unloading arm is used to transfer the components or work pieces from one workstation to the other.

WEIGHING MODULE



The Weighing module consists of two elements: the load cell and the interface circuit. The load cell generates a variable resistance value related to the weight of the object that is placed over it.

The interface circuit receives, processes and sends this value to the analogue input of the PLC, which determines the correspondent weight of the work piece placed over the load cell.

DRILLING MODULE



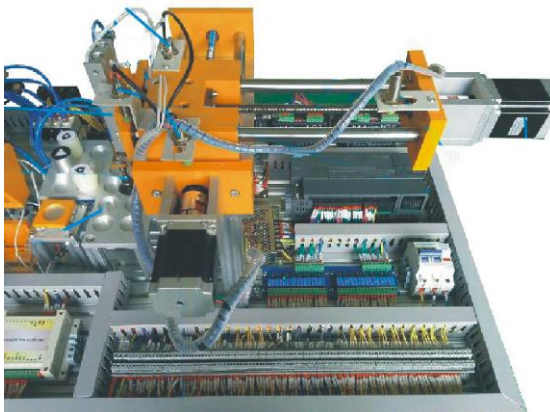
The Module simulates the function of drilling the work piece. The PLC tells the vertically double acting flat cylinder to position the drilling device near the work piece and to start the drilling device.

VISION INSPECTION SYSTEM



The vision system is a compact visual sensing equipment, which is used for quality control inspections in automated production lines. The vision system serves under the class of visual sensing methods. The vision system basically analyzes an image obtained by a video camera, displays it and reports its characteristics to the system controller.

PALLETIZER UNIT



The Palletizer is used for palletizing (placing) the work piece in a particular order. Our XY Palletizer is a stepper motor controlled unit. The motor controls the movement and the position of the axis of the Palletizer. For workpiece handling, a suction cup is provided which is controlled using a flat cylinder - double acting. The cylinder will extend & retract to pick up or dispense the workpiece.

SOFTWARE

The system includes the software for programming the PLC. PC is not included.

On request, it can also be supplied with a Supervisory Control And Data Acquisition (**SCADA**) software and provided with a 7" Human Machine Interface (HMI). The software interfaces with the CIM's PLC.

The ordering codes for the CIM versions that include the SCADA software are the following:

AMTEC MEASURING INSTRUMENTS



Multimeter

Insulation tester



**Digital Loop &
PSC tester**

Voltage Detector



Clamp meter



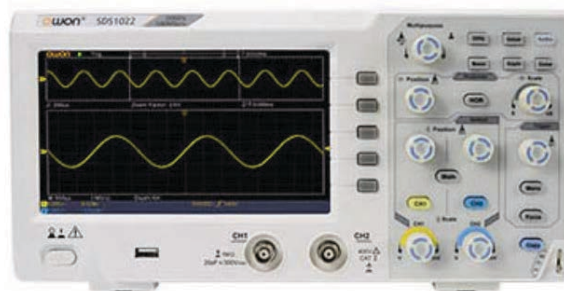
Phase rotation meter



**Earth Leakage
tester**



Digital and Analog Oscilloscope



LUX Meter



Sound level meter



Earth Resistance tester



Power meter



Line and Voltage Detector



AMTEC HYDRAULICS AND PNEUMATICS

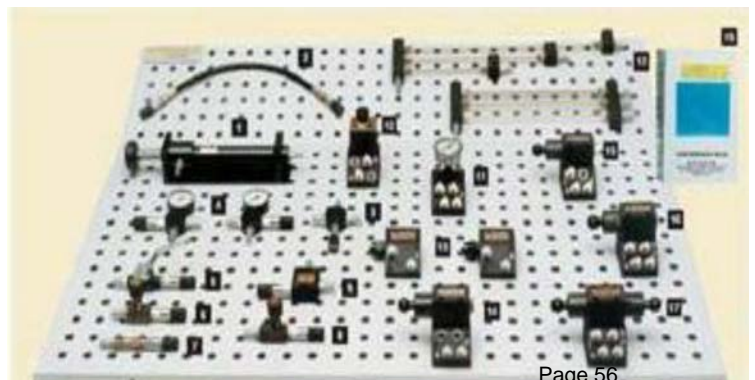
We offer:

- Single sided workstation
- Double sided workstation
- Dual workstations
- SDP and TTC component sets
- Electrohydraulic component sets
- Electro Pneumatic component sets
- Proportional Hydraulics component sets



Advantages:

- Easily assembled
- Plug and play components
- Full after sales services
- Spares readily Available
- 2-year warranty
- Locally supported





AMTEC DVD LIST

Amtec Techniquip has training DVDs and manuals available for common processes in the various Engineering workshop teaching various principles from safety in the workplace to various machines.

We have the following DVD's available for the Engineering Workshop.

DVD Description	PART NO	COURSE
AC & DC MACHINES DVD + 2 MANUALS	AMTECDVD001	Electrical
AC INDUCTION MOTORS DVD + 2 MANUALS	AMTECDVD002	Electrical
AIR CONDITIONING & REFRIGERATION DVD + 2 MANUALS	AMTECDVD003	AC
ANALOGUE OSCILLOSCOPE DVD + 1 MANUAL	AMTECDVD004	Electronics
AUTO ELECTRICAL TESTING DVD + 1 MANUAL	AMTECDVD005	Auto Electrical
AUTOMATIC PROCESS CONTROL DVD + 2 MANUALS	AMTECDVD006	Instrumentation
AUTOMOTIVE ELECTRICAL MAINTENANCE DVD + 1 MANUAL	AMTECDVD007	Auto Electrical
BASIC BEARING MAINTENANCE DVD + 2 MANUALS	AMTECDVD008	Mechanical
BASIC CENTRIFUGAL PUMPS DVD + 2 MANUALS	AMTECDVD009	Mechanical
BASIC HAND TOOLS DVD + 2 MANUALS	AMTECDVD010	Various
BASIC HYDRAULIC MAINTENANCE DVD + 2 MANUALS	AMTECDVD011	Mechanical
BELT AND CHAIN DRIVES DVD + 1 MANUAL	AMTECDVD012	Mechanical
BRAZING AND BRAZE WELDING DVD + 2 MANUALS	AMTECDVD013	Mechanical
COMPOUND MITRE SAW DVD + 1 MANUAL	AMTECDVD014	Mechanical
COMPRESSED AIR SYSTEMS DVD + 2 MANUALS	AMTECDVD015	Mechanical
CONFINED SPACES DVD + 2 MANUALS	AMTECDVD016	Various
DRILLING TAPPING AND THREADING DVD + 2 MANUALS	AMTECDVD017	Mechanical
ELECTRICAL ANGLE GRINDER DVD + 2 MANUALS	AMTECDVD018	Mechanical
ELECTRICAL CONSTRUCTION OPERATOR DVD + 2 MANUALS	AMTECDVD019	Electrical
ELECTRICAL TEST EQUIPMENT DVD + 2 MANUALS	AMTECDVD020	Electrical
ELECTRICITY IN THE WORKPLACE DVD + 2 MANUALS	AMTECDVD021	Electrical
ESSENTIAL KNOWLEDGE FOR WELDERS DVD + 1 MANUAL	AMTECDVD022	Welding
FIRE SAFETY SERIES DVD + 1 MANUAL	AMTECDVD023	Various
FIRE SAFETY FOR OFFICES DVD - NO MANUALS	AMTECDVD024	Various
FORKLIFT OPERATOR TRAINING 2 DVDs + CD ROM	AMTECDVD025	Fork Lift
GAS HAZARD AWARENESS DVD + 1 MANUAL	AMTECDVD026	Welding
GAS METAL ARC WELDING DVD + 1 MANUAL	AMTECDVD027	Welding
GAS SAFETY - PORTABLE CYLINDER HANDLING DVD + 1 MANUAL	AMTECDVD028	Welding
GEARED REDUCTION UNITS DVD + 1 MANUAL	AMTECDVD029	Mechanical
GENERAL SAFETY IN THE WORKPLACE 2 DVDs + CDROM	AMTECDVD030	Various
GENERAL WELDING SAFETY DVD + 1 MANUAL	AMTECDVD031	Welding
GRINDING MACHINES DVD + 2 MANUALS	AMTECDVD032	Mechanical
LEAD ACID BATTERIES DVD + 2 MANUALS	AMTECDVD033	Electrical
LIGHT DUTY HAND SOLDERING DVD + 1 MANUALS	AMTECDVD034	Electrical
LIGHT VOLTAGE JOINTS DVD + 1 MANUAL & EVJ MANUAL	AMTECDVD035	Electrical
LUBRICATION DVD + 1 MANUAL	AMTECDVD036	Mechanical
MEASURING & MARKING (BASIC ENG SKILLS) DVD + 1 MAN	AMTECDVD037	Mechanical
MECHANICAL COUPLING ALIGNMENT DVD + 2 MANUALS	AMTECDVD038	Mechanical
MECHANICAL THREADED FASTENERS DVD + 1 MANUAL	AMTECDVD039	Mechanical
MEDIUM VOLTAGE JOINTS 2 DVDs - NO MANUALS	AMTECDVD040	Electrical
OXY/ACETYLENE EQUIPMENT DVD + 2 MANUALS	AMTECDVD041	Welding
OXY/ACETYLENE PROCESS DVD + 2 MANUALS	AMTECDVD042	Welding
PRECISION MEASURING INSTRUMENTS DVD + 2 MANUALS	AMTECDVD043	Welding
PRESSURE VESSEL TESTING DVD + 1 MANUAL	AMTECDVD044	Mechanical
PROGRAMMABLE LOGIC CONTROLLERS DVD + 2 MANUALS	AMTECDVD045	Electrical
SAFE LIFTING & MOVING 2 DVDs + CD ROM	AMTECDVD046	Various
SEALS & GASKETS DVD + 2 MANUALS	AMTECDVD047	Various
SHIELDED METAL ARC WELDING DVD + 2 MANUALS	AMTECDVD048	Welding
TUNGSTEN INERT GAS WELDING DVD + 2 MANUALS	AMTECDVD049	Welding
VALVES AND VALVE MAINTENANCE DVD + 2 MANUALS	AMTECDVD050	Mechanical
WORKING WITH PORTABLE LADDERS DVD + 2 MANUALS	AMTECDVD051	Mechanical

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Engineering The Future



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"Please feel free to contact us should you require a Quotation or Technical information & datasheets"

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- ✦ Auto-Electrical & Auto-tronics
- ✦ Chemical Engineering
- ✦ Civil Engineering
- ✦ Electrical - Domestic & Industrial
- ✦ Electronics - Digital Systems & Process control
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