Instrumentation and Process Control Training Equipment

Process Automation

User Guide

Festo Didactic
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8115241

Process Control

Instrumentation and Process Control Training Equipment

Safety Instructions and Commissioning

8115241

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By the staff of Festo Didactic

Internet: www.festo-didactic.com
e-mail: services.didactic@festo.com

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Safety and Common Symbols

The following safety and common symbols may be used in this course and on the equipment:

Symbol	Description
DANGER	**DANGER** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
CAUTION	**CAUTION** used without the *Caution, risk of danger* sign ⚠, indicates a hazard with a potentially hazardous situation which, if not avoided, may result in property damage.
	Caution, risk of danger. Consult the relevant user documentation.
	Caution, risk of electric shock
	Caution, lifting hazard
	Caution, hot surface
	Caution, risk of fire
	Caution, risk of explosion
	Caution, belt drive entanglement hazard
	Caution, chain drive entanglement hazard
	Caution, gear entanglement hazard
	Caution, hand crushing hazard
	Notice, non-ionizing radiation
	Consult the relevant user documentation.
	Direct current
	Alternating current
	Both direct and alternating current

Symbol	Description
	Three-phase alternating current
	Earth (ground) terminal
	Protective conductor terminal
	Frame or chassis terminal
	Equipotentiality
	On (supply)
	Off (supply)
	Equipment protected throughout by double insulation or reinforced insulation
	In position of a bi-stable push control
	Out position of a bi-stable push control

Table of Contents

1 About this Manual

The operator should familiarize himself/herself with the contents of this manual before installing and operating the equipment.

The Safety Symbols table at the beginning of this manual lists safety symbols that may be present in this manual or on the equipment.

This manual is freely available for download from the Festo Didactic website.

Upon request, printed copies of this manual are freely available. Contact your Festo Didactic sales representative.

> **Important.** In this manual, "the equipment" and/or "the training system" specifically refers to the Instrumentation and Process Control equipment.

2 General Requirements for Operating the Equipment

General requirements for safe operation of electrical equipment:

- National regulations for operating electrical systems and equipment must be observed in commercial facilities.

- The laboratory or classroom must be overseen by a supervisor.
  - A supervisor is a qualified electrician or a person who has been trained in electrical engineering, knows the respective safety requirements and regulations, and whose training has been documented accordingly.

- Installation and commissioning of the equipment must be performed as directed in the accompanying documentation before any person can use the equipment for its intended purpose.

- Damaged or defective equipment must never be used.
  - Damaged devices must be barred from further use and removed from the laboratory or classroom.
  - Damaged connection cables and leads, pneumatic tubing, and hydraulic hoses represent a safety risk and must be removed from the laboratory or classroom.

Regulation in certain countries requires that the laboratory or classroom is equipped with the following devices:

- The ac power outlets in the laboratory or classroom must be protected by residual current devices (RCDs).
  - Electrical equipment (e.g., power supply units, compressors, hydraulic power units, etc.) may only be operated in training rooms which are equipped with residual current devices (RCDs).

  - Type A or type B residual current circuit breakers with a residual current set in accordance with the local regulation (generally ≤ 30 mA) must be used to protect the ac power outlets in the laboratory or classroom.

- The ac power outlets in the laboratory or classroom must be protected by overcurrent protection devices.
  - Circuit breakers or fuses.

For additional safety, the laboratory or classroom can also be equipped with the following devices:

- One or several energy-off devices can be provided.
  - An emergency-off device can be provided to turn electric power off for the whole laboratory or classroom.
  - An emergency-off device can be provided at each workstation to turn electric power off at the workstation only.

- The laboratory or classroom can be secured so that operating voltage and compressed air supply cannot be activated by unauthorized persons, for example by means of:
  - Lockable power-on switches.
  - Lockable on-off valves.

3 Use for Intended Purpose

The equipment may only be used:

- For its intended purpose in teaching and training applications.
- When its safety functions are in flawless condition.

The components of the equipment are designed in accordance with the latest technology and recognized safety rules. However, life and limb of the user and third parties may be endangered and the equipment may be impaired if it is used improperly.

The learning program from Festo Didactic has been developed and produced exclusively for basic and advanced training in the field of instrumentation and process control. To ensure the safety of the trainees during their training, the training company and/or supervisors must make sure that all trainees use the equipment as directed in the accompanying Festo Didactic training manuals, and observe the safety instructions and precautions in the present manual.

3.1 Guarantee and Liability

Our “general terms and conditions of sale and delivery” are always applicable. These are made available to the operating company no later than on conclusion of the sales contract. Guarantee and liability claims resulting from personal injury and/or property damage are excluded if they can be traced back to one or more of the following causes:

- Use of the equipment for anything other than its intended purpose.
- Improper commissioning and/or operation of the equipment.

- Use of the equipment with defective safety equipment, or with improperly attached or non-functional safety and protective equipment.
- Non-compliance with instructions included in the core documentation with regard to commissioning and operation.
- Unauthorized modifications to the equipment.
- Improperly executed repairs.
- Disasters resulting from the influence of foreign bodies and acts of nature.

Festo Didactic hereby excludes any and all liability for damages suffered by trainees, the training company, and/or any third parties, which occur during use of the equipment in situations which serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

4 For your Safety

4.1 Important information

Fundamental prerequisites for safe use and trouble-free operation of the equipment include knowledge of basic safety precautions and safety regulations. This manual includes important instructions for safe use of the equipment.

In particular, the safety precautions must be adhered to by all persons who work with the equipment. In addition, all pertinent accident prevention rules and regulations, which are applicable at the respective place of use, must be adhered to.

4.2 Obligations of the operating company

The operating company only permits those who meet the following qualification to work with the equipment:

- Persons that are familiar with the basic regulations regarding work safety and accident prevention, and have been trained in the use of the equipment.
- Persons that have read and understood the chapter concerning safety and the warnings in this manual.

Personnel should be tested at regular intervals for safety-conscious work habits.

4.3 Obligations of the trainees

All persons who have been entrusted to work with the equipment must complete the following steps before beginning work.

- Read the chapter concerning safety and the warnings in this manual.
- Familiarize themselves with the basic regulation regarding work safety and accident prevention.

5 Work and Safety Instructions

5.1 General

⚠ WARNING

Presence of dangerous voltage!

- The equipment conducts dangerous voltage which may be dangerous. Disregard of the warnings and/or non-observance of the safety instructions in this manual may result in life-threatening danger, severe injury, or major damage to property.

⚠ CAUTION

- Trainees should only work with the equipment under the supervision of a qualified supervisor.
- Always use the equipment as directed in the accompanying Festo Didactic training manuals.
- Observe the specifications included in the technical data for the individual components, and in particular, all safety instructions.
- Set the equipment up so that activation of switches and disconnectors is not made difficult.
- Any equipment malfunction which may impair safety must be eliminated immediately.
- Wear personal safety equipment (safety glasses, safety shoes, etc.) when working with the equipment.

5.2 Electrical system

⚠ WARNING

- **Risk of death in case of missing or interrupted protective earthing conductor!**
  - Equipment with protective earthing terminals must always be earthed.
  - Protective earthing connections must always be established first (i.e., before establishment of connections to voltage sources) and removed last (i.e., after removal of all connections to voltage sources).
  - The protective earthing conductors (yellow-green) must not be interrupted, either inside or outside of any device.
  - The insulation of the protective conductors must never be damaged or removed.

- **Risk of death due to electric shocks!**
  - Contact voltages greater than 25 V AC or 60 V DC are not permissible.
  - Coming into contact with voltages greater than 33 V AC or 70 V DC may be fatal.
  - Use only cable or leads with adequate insulation and electric strength.
  - Switch all power supply units off before working on electrical circuits. Electrical connections may only be established or removed in the absence of voltage.

⚠ CAUTION

- Parts (e.g., large capacitors) in electrical equipment may remain charged at dangerous voltage levels for a certain time after the equipment has been disconnected from all sources of electrical power. Such parts become accessible when opening the equipment housing, thereby resulting in a risk of electric shock. Wait a few minutes after disconnection of the power sources before working on any piece of equipment.
- Hazard-free operation of the equipment is no longer possible in the case of visible damage, malfunction, incorrect storage, or incorrect transport. In any of these situations, turn electric power off immediately and protect the equipment against inadvertent use.

CAUTION

- When laying cables and leads, make sure that they are not kinked or pinched.
- Do not lay cables or leads over hot surfaces. Hot surfaces on the equipment are identified with the corresponding safety symbol.
- Always pull on the plug when disconnecting cables or leads. Never pull on the cable or lead itself.
- Make sure that connection cables and leads are not subjected to continuous tensile loads.
- Maximum permissible load currents for the devices and connection cables or leads must not be exceeded.
  - Always compare the current ratings of the device, the cables or leads, and the overcurrent protection (fuse or circuit breaker). If necessary, use an upstream fuse or circuit breaker to achieve proper overcurrent protection.
- Make sure that you use detachable mains supply cords with adequate rating.
- When replacing fuses in the equipment, use specified fuses only with the correct current rating and tripping characteristic.
- The equipment may generate high-frequency interference in residential areas, which may make it necessary to implement interference suppression measures.

6 Equipment Installation and Commissioning

6.1 Environmental requirements

The equipment is designed to be installed indoors and must be operated in the following environmental conditions to ensure user safety:

- an altitude up to 2000 m (6560 feet)
- a temperature between 5°C and 40°C (between 41°F and 104°F)
- a maximum relative humidity of 80% for temperatures up to 31°C (88°F), decreasing linearly to 50% relative humidity at 40°C (104°F)
- mains supply voltage fluctuations which do not exceed ±10% of the nominal voltage
- transient overvoltage up to the levels of overvoltage category II
- temporary overvoltage occurring on the mains supply: 2500 V
- a pollution degree of 2 in accordance with IEC 60664-1

> The word pollution used above refers to any addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity.

Make sure that the location where you want to install the equipment meets the environmental requirements listed above, and then follow the directives given in the next sections to safely install and use the equipment.

Trainees must have basic electrical knowledge before using the equipment and a qualified instructor must supervise the training sessions.

6.2 Handling and installing modules

6.2.1 Module handling

Before handling any module, make sure of the following:

- You know where to install or move the module.
- No obstacle is in the way. The floor is not bumpy, obstructed, or slippery.
- You are strong enough to lift and carry the module to its intended location. Assess the module weight beforehand, if necessary.

When carrying any module, make sure of the following:

- Keep a good grip on the module.
- If the module has handles, always use them to carry it.
- Keep the module as close as possible to the waist, with the shoulders level. Never hold the module at arm's length or away from the body.
- Move slowly while keeping the body and feet in a stable position.
- Turn by turning the feet, NOT the back.

7 Safety Precautions

7.1 Preliminary warning

Even though the equipment has been carefully designed to ensure trainees' safety, there are residual risks that cannot be reduced via technical solutions without impairing the learning process. The first and foremost safety measure that must be enforced at all times is the proper supervision of the trainees.

Nothing can replace the supervision and guidance of a qualified instructor. Trainees have an incomplete mastery of the subject. They can make mistakes and most certainly will. That is an essential part of the learning process.

The role of the instructor is to let trainees make mistakes that have no consequences on their safety, while protecting them from mistakes that can have unfortunate consequences.

⚠ CAUTION

Nothing can replace the supervision and guidance of a qualified instructor.

7.2 General warnings

⚠ WARNING

- Before operating the equipment, make sure that the leads used to interconnect the protective earthing terminals of the modules form a protective earthing conductor that is not interrupted. Also, make sure that the insulation of each of these leads is not damaged or removed.
- Before making or modifying any connections on the equipment, always make sure that the power supply is turned off.

⚠ CAUTION

- Set the modules up so that activation of switches and disconnectors is not made difficult.
- Wear personal safety equipment when working on electrical circuits. Refer to the *Personal protective equipment (PPE)* section.

⚠ CAUTION

There is a risk of personal injury, such as intervertebral disk injury, when transporting or mounting modules that are heavier than 15 kg. Ask for assistance.

CAUTION

- The equipment is part of the EMC Class A (CISPR 11:2009) products. In a domestic environment, these products may cause radio interference, in which case the user may be required to take adequate measures.

7.3 Indication of conformity

The equipment is in conformity with the following directives and standards:

- Low Voltage Directive (LVD) 2014/35/EU
  - EN 61010-1:2010 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
- Electromagnetic Compatibility Directive (EMC) 2014/30/EU
  - IEC 61326-1:2012- Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
- Restriction of the use of certain Hazardous Substances Directives (RoHS) 2011/65/EU
  - EN 50581:2012-09 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

7.4 Degrees of ingress protection (IP)

The equipment is rated IP20.

CAUTION

The equipment is not protected against liquid infiltration or immersion. Keep it away from all types of liquids. Failure to do so could damage the equipment.

7.5 Personal protective equipment (PPE)

Even with all the safety features implemented on the equipment, there are still residual risks due to misuse or defective part(s). To further reduce the risks of injury, always follow the rules below when using the equipment:

- If the modules need to be moved often from the storage room to the workstation or from one workstation to another, wear safety shoes.
- Do not wear anything that might get caught such as a tie, jewelry, or loose clothes.
- Tie back long hair.
- Clean the working area, it must be free of oil and water.

7.6 Equipment modification

Do not modify the equipment without prior written permission of Festo Didactic. The equipment uses complex industrial components and modifications could have undesired consequences on product integrity and safety.

8 Equipment Description

This section identifies the main components (connectors, controls, displays, indicators, etc.) on the equipment. It may also provide safety directives and/or operating instructions specific to certain pieces of equipment as well as instructions for the replacement of parts in the equipment.

8.1 CompactLogix PLC

This PLC is manufactured by Rockwell and is part of the CompactLogix family. It is divided into modules arranged on a DIN rail. This rail is installed on a panel that is easily installed on the instrumentation workstation. The wiring of the PLC can be done using either the banana jacks or the terminal screws available on the panel.

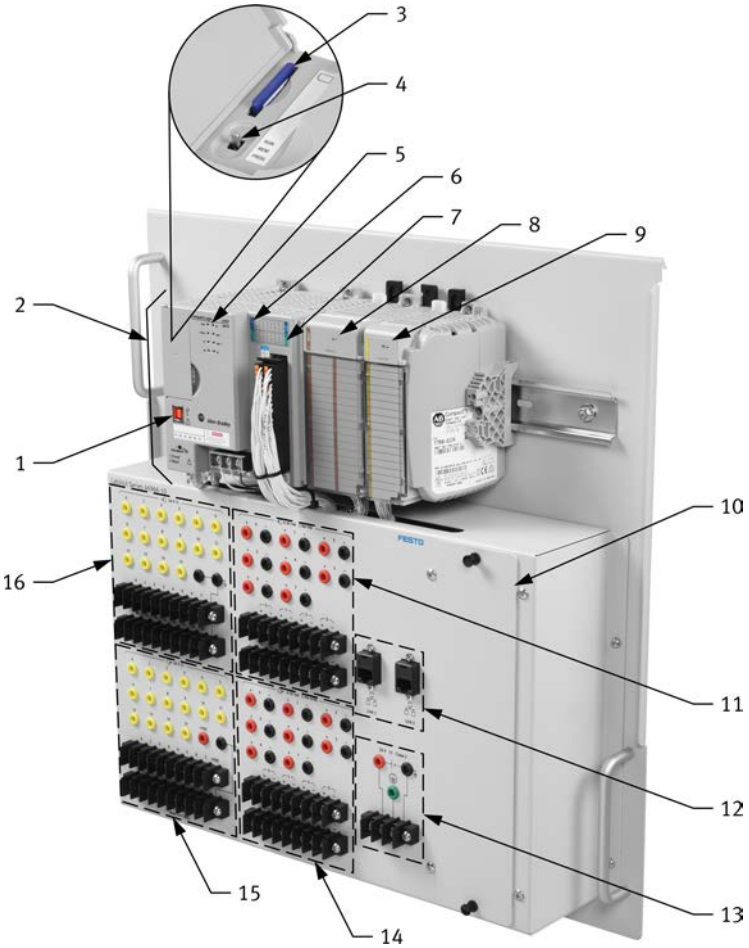

Figure 8-1. Front panel of the CompactLogix PLC module.

Number	Component name
1	USB port
2	Controller
3	SD memory card
4	Mode key
5	CPU indicators
6	Digital-input display
7	Digital-output display
8	Analog-input module
9	Analog-output module
10	Fault panel
11	Analog-input connectors (4–20 mA 1769-IF8)
12	Ethernet I/P remote connectors
13	Power-input connectors (24 V dc, Class 2, 2.1 A)
14	Analog-output connectors (4–20 mA 1769-IF8)
15	Digital-output connectors (24 V dc, 0.4 A, max. 4 A total)
16	Digital-input connectors (24 V dc)

Table 8-1. Description of the CompactLogix PLC module.

9 Equipment Maintenance

The equipment is designed to ensure user safety and long-term reliability. Nevertheless, care must be taken so that the equipment remains in good operating condition and thus safe to the user.

This section provides directives and guidelines for the maintenance of the equipment.

⚠ WARNING

Instructors and/or the personnel in charge of laboratory equipment should transmit the following directions and guidelines to students because they play an important role in maintaining the equipment in good operating condition.

9.1 General maintenance

The equipment does not require any particular maintenance. However, it is very important to perform a visual inspection of the equipment before each laboratory exercise. If a piece of equipment appears damaged or shows wear, it must be replaced to ensure user safety and prevent further damage to the equipment.

There are no user serviceable parts inside the equipment, other than certain parts that may need to be replaced, such as fuses, button cells, batteries, etc. Opening or removing the equipment housing to replace

parts may expose you to dangerous voltages. Do not try to open the equipment housing to replace parts. Have a qualified technician replace parts in the equipment.

9.2 Consumables and replacement parts

It is possible to replace certain pieces of equipment that are consumable or that have been damaged. Use only Festo Didactic parts and accessories to ensure compatibility and sustainability of the equipment. Available replacements parts and accessories are listed below.

Part	Type	Rating	Order no.
Connection leads			
Connection lead	2 mm connection lead	100 mm, 500 V CAT II, 5 A, 0.5 mm^2	574200
		200 mm, 500 V CAT II, 5 A, 0.5 mm^2	574203
		300 mm, 500 V CAT II, 5 A, 0.5 mm^2	574204
		500 mm, 500 V CAT II, 5 A, 0.5 mm^2	574205
Cables			
Network cable	RJ45 male-male	3048 mm	776778

Table 9-1. List of consumable pieces and damageable equipment.

9.3 Disposal

Do not discard the equipment with normal waste: it contains electrical and electronic components. A specialist must dismantle the product. Each component must be recycled or disposed of according to your local legislation.

It is the owner's responsibility to make provisions for the equipment recycling and safe disposal.

9.4 Cleaning

To clean the front panel(s) and housing(s) of the equipment, use a soft cloth and a mild solution of detergent and water. It is important not to apply the solution directly onto the surface of the module. Instead, apply the solution onto the soft cloth.

CAUTION

Unless specifically stated otherwise, do not use abrasive substances or solvents to clean any part of the equipment.

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CE Importer:
Festo Didactic SE
Rechbergstr. 3
73770 Denkendorf
Germany
Tel.: +49 711 3467-0
did@festo.com

US Importer:
Festo Didactic Inc.
607 Industrial Way West
Eatontown, NJ 07724
United States
Tel.: +1 732 938-2000
Toll Free: +1-800-522-8658
services.didactic@festo.com

CA Manufacturer:
Festo Didactic Ltée/Ltd
675, rue du Carbone
Québec (Québec) G2N 2K7
Canada
Tel.: +1 418 849-1000
Toll Free: +1-800-522-8658
services.didactic@festo.com

UK Importer:
Festo Ltd
Applied Automation Centre
Brackmills
Northampton, NN4 7PY
United Kingdom
T +44 800 626 422
info_gb@festo.com

www.festo-didactic.com

0008115241000000000100