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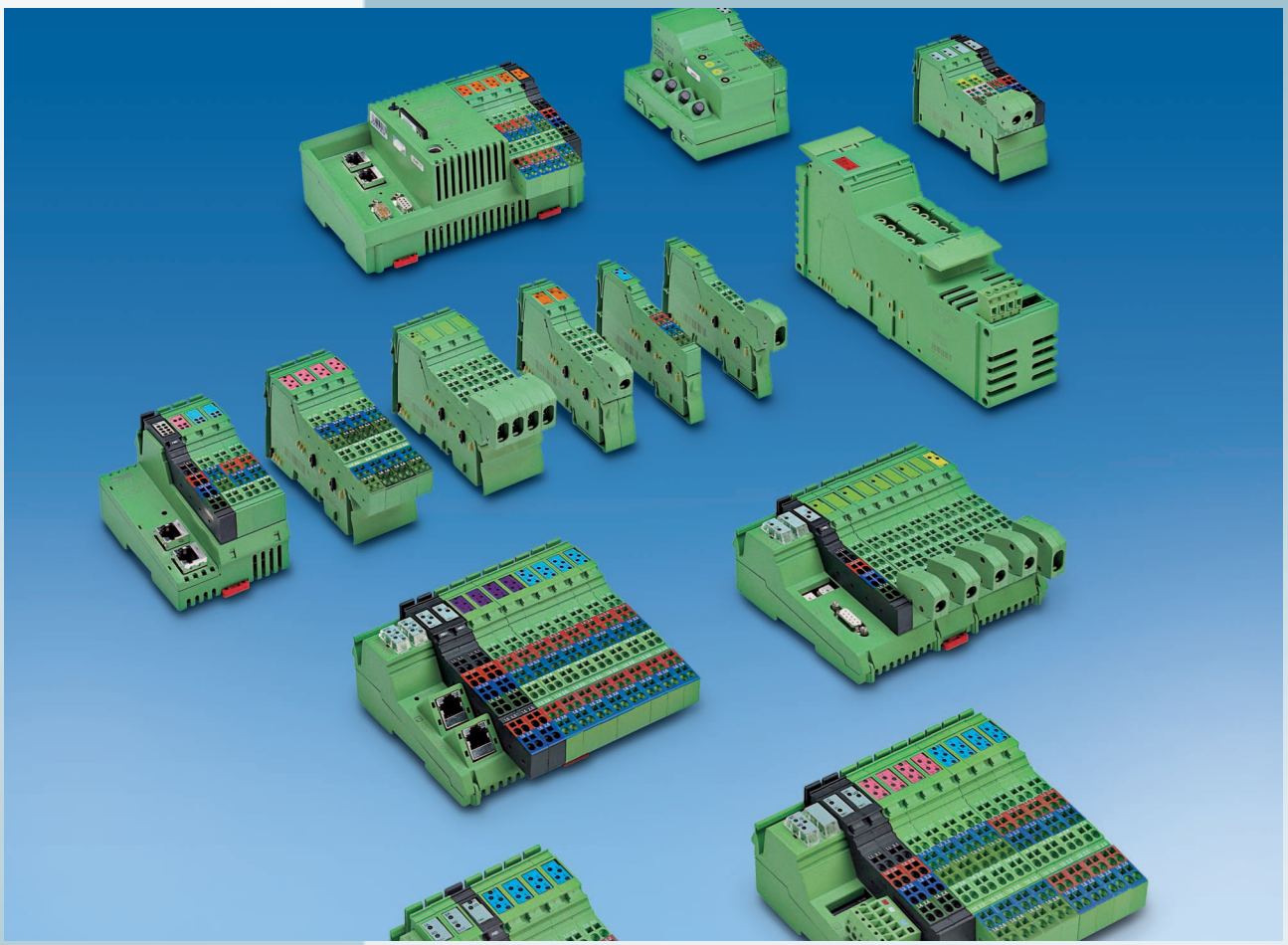

Automation terminals of the Inline product range

User manual

PHOENIX CONTACT
INSPIRING INNOVATIONS

User manual

Automation terminals of the Inline product range

2017-04-25

Designation: IL SYS INST UM E

Revision: 08

This user manual is valid for:

All automation terminals in the Inline product range without bus couplers and bus-specific special features

Please observe the following notes

User group of this manual

The use of products described in this manual is oriented exclusively to qualified electricians or persons instructed by them, who are familiar with applicable standards and other regulations regarding electrical engineering and, in particular, the relevant safety concepts.

Explanation of symbols used and signal words

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

DANGER This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.

This symbol and the accompanying text provide the reader with additional information or refer to detailed sources of information.

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Table of Contents

1 Documentation landscape of Inline

The documentation for the Inline product range is modular, providing you with the optimum information for your specific bus system, Inline Modular IO terminal or Inline Block IO module.

The documentation can be downloaded at phoenixcontact.net/products.

For a comprehensive list of the documentation, please refer to the ordering data (see Section “Ordering data” on page 153).

Terminal-specific documentation can be found in the download area for the corresponding device.

Make sure you always use the latest documentation.

"Automation terminals of the Inline product range" user manual, IL SYS INST UM E (this manual)

For Inline Modular IO and Inline Block IO.

This manual is the higher-level system manual for Inline and describes the use of terminals/modules for all bus systems.

User manuals (system, bus coupler or special terminal)

For Inline Modular IO.

The additional user manuals either describe:

– A bus system (e.g., INTERBUS)
– A bus coupler in association with a bus system (e.g., PROFIBUS DP) or
– A special Inline terminal (e.g., counter terminal, positioning terminal)

Each manual only describes the relevant terminal and/or bus-specific special features. As the higher-level manual, the "IL SYS INST UM E" user manual also applies.

"INTERBUS & AUTOMATION - Terms and definitions" reference manual, IBS TERM RG UM E

This manual provides an overview of technical terms and definitions in the field of INTERBUS & AUTOMATION.

Quick Start Guides

For Inline Modular IO.

A Quick Start Guide is available for various topics. A Quick Start Guide describes the startup of a system or a terminal step-by-step using an example.

Terminal/module-specific data sheets

For Inline Modular IO and Inline Block IO.

The data sheet describes the specific properties of each device.
This includes at the very least:

- Function description
- Local diagnostic and status indicators
- Pin assignment/terminal point assignment and connection example
- Programming data/configuration data
- Technical data

Application notes

For Inline Modular IO and Inline Block IO.

Application notes provide additional information about special topics, such as:

– Overview of Inline terminals that can be used at various bus couplers	AH IL BK IO LIST The document will be replaced by the Project+ configuration software.
– Information about addressing 16-channel Inline Block IO modules	AH ILB 24 DI/DO 16 ADDRESS
– Information about addressing 32-channel Inline Block IO modules	AH ILB 24 DI/DO 32 ADDRESS
– General information about the safety-related segment circuit	AH EN IL SAFE
– General information about use in zone 2 potentially explosive areas	AH EN IL EX ZONE 2
– Example for the use of a terminal with a specific software tool	
– Example for the communication of a terminal with a specific control system	
– Information about firmware versions of specific terminals	
– Information about firmware updates	

Package slips

For Inline Modular IO and Inline Block IO.

A package slip contains key information for the electrical installation of a device or group of devices. This includes, for example:

- Short description
- Safety notes
- Mounting/removal
- Terminal point assignment

2 The Inline product range

The Inline product range consists of:

– Inline Modular IOs: Modular terminals
– Inline Block IOs: Compact remote I/O modules

This manual mainly describes the Inline Modular IOs, which are referred to as Inline terminals. For information about the Inline Block IOs, please refer to the module-specific data sheets.

2.1 Features

Inline Modular IO

– Can be easily installed side by side without tools
– Open, flexible, and modular structure
– Terminals of varying widths can be combined to create a time-saving, compact, and cost-effective station structure
– 2-slot terminals:
These terminals enable optimum adaptation to the desired configuration. They enable a flexible and compact station structure without unnecessary reserve installation space.
– 8-slot terminals:
These terminals provide a fast and effective station structure for larger stations.
– Functional orientation of the control box or control cabinet
The modular structure makes it possible to assemble standard function blocks in advance. Parts of the system can be started up independently of one another. This means that pretests can be carried out when the system is set up and the whole system can be adapted and extended.
– Automatic creation of isolated groups, potential circuits, and data circuits
– The amount of costly parallel wiring is reduced
Within a station, potential and data routing can be carried out without additional wiring.
– Supports all popular bus systems

Inline Block IO

– Integrated bus interface for all popular bus systems
– High channel density
– Compact 55 mm flat design
– Can be easily installed without tools
– Same look and feel as Inline Modular IO

2.2 Product description

Automation terminals with various functions are available within the Inline product range.

With just a few exceptions, the automation terminals consist of an electronics base (Inline Modular IO) or an electronic module (Inline Block IO) and one or more connectors for connecting the I/O or power supply. The electronics can be replaced without removing a single wire from the connector.

Inline Modular IO versions

The Inline product range offers terminals for all automation tasks:

- Bus couplers to integrate the Inline station into various bus systems, some with input and output function for digital signals
  The bus can be connected using copper or fiber optic technology.
- Terminals with remote bus branch for opening an INTERBUS remote bus branch
  The remote bus branch can be connected using copper or fiber optic technology.
- Terminals for supplying the supply voltages and segmenting the station (with and without fuse)
- Accessory terminals (potential distributor terminals, distance terminals)
- Input and output terminals for digital and analog signals
- Power-level terminals for switching, protecting, and monitoring three-phase standard motors
- Branch terminals for integrating further product ranges (e.g., integration of a Fieldline Modular local bus in the Inline station) or to extend the local bus by several rows
- Terminals for open and closed-loop control, communication, and position detection
- Safety modules
- Programmable terminals (CPU and Inline Controller)

Inline Block IO versions

- Input modules, output modules, and I/O modules for digital and analog signals
- Bus interface is integrated in the module

Mounting location

Inline Modular IO terminals and Block IO modules meet IP20 protection. They can be used in closed control cabinets or in control boxes (terminal boxes) with IP54 protection or higher according to EN 60529. The compact design means that most Inline Modular IO terminals and all Block IO modules can be installed in standard terminal boxes.

Please observe the mounting distances when selecting the housing (see Section “Mounting distances” on page 101).

Mounting

Inline Modular IO terminals and Block IO modules can be snapped onto DIN rails without tools. Potential and data jumpers are automatically created when the Inline Modular IO terminals are properly installed.

See Section “Mounting/removing devices” on page 99.

Bus connection (network)

Inline Modular IO: The Inline station is integrated in the bus system via a bus coupler or controller. The bus is controlled by the Inline station through data routing.

Inline Block IO: The bus interface is integrated in the module. The bus is connected directly to the I/O module.

I/O connection

The Inline terminals and Block IO modules have connectors for 1, 2, 3, and 4-wire sensors or actuators. The wires are connected using spring-cage technology. For more detailed information, please refer to the individual sections.

3 Important information about voltage areas

3.1 Voltage areas for Inline Modular IO and Inline Block IO

Inline Block IO modules are available for the SELV area

Inline Modular IO terminals are available for the SELV and low voltage areas. The terminals are divided into three product groups according to their use in a specific voltage area and their function.

Table 3-1 Voltage areas and corresponding terminal designations for Inline

Voltage area	Voltage used for Inline	Product group
SELV	24 V DC	Low-level signal terminals; Inline Block IO modules
Low voltage	120 V AC	Low voltage terminals; AC terminals
	230 V AC	
	400 V AC	Power-level terminals

Observe the safety notes in the following sections when working outside the SELV area.

3.2 Correct usage

Inline Block IO modules and Inline Modular IO terminals should only be used according to the instructions in the terminal-specific data sheets and this user manual. Phoenix Contact accepts no liability if the device is used for anything other than its designated use.

When used in the SELV area:

NOTE: Disregarding this warning may result in malfunction

Do not replace terminals while the power is connected.

Before removing or mounting a terminal, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

When used in the low voltage area:

WARNING: Dangerous contact voltage

Do not replace terminals while the power is connected.

Before removing or mounting a terminal, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

WARNING: Dangerous contact voltage

Please note that there are dangerous contact voltages when switching circuits that do meet SELV requirements.

When working on the terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

3.3 Notes for Inline Modular IO

3.3.1 Safety notes for use in the low voltage area

Only qualified personnel (qualified electricians or persons instructed in electrical engineering) may work on Inline terminals outside the SELV area.

The instructions given in the terminal-specific data sheets must be followed during installation and startup.

An **electrician** is a person who, because of their education, experience, and instruction, and their knowledge of relevant standards, can assess any required operations and recognize any possible dangers. (Definitions according to DIN VDE 1000-10:1995).

A **person instructed in electrical engineering** is someone who has been instructed by an electrician in their required tasks and the possible dangers caused by incorrect handling and, if necessary, has also been informed of the necessary safety equipment and safety measures. (Definitions according to DIN VDE 1000-10:1995).

3.3.2 Safety notes for electrical equipment used in industrial plants with a 400 V AC voltage

WARNING: Dangerous contact voltage

The electrical power-level terminals for the 400 V AC area and connected machines refer to equipment used in industrial plants. During operation, this equipment has dangerous, live, moving or rotating parts. These can therefore cause considerable damage to health or equipment, e.g., due to the unauthorized removal of protective covers or inadequate maintenance.

- Only qualified personnel may work on the power-level terminals or system (for the definition, see Section 3.3.1 on page 16).
- When working on the power-level terminals and the system, you must always keep the operating instructions and other items of product documentation to hand and observe the information therein.
- It is prohibited for unqualified personnel to work on the power-level terminals, on the machine or in their vicinity.

The instructions given in the terminal-specific data sheets must be followed during installation and startup.

The notes on the procedures and the circuit details presented in the terminal-specific data sheets should be understood in a general sense and the relevant application should be tested to see if they apply.

Phoenix Contact cannot guarantee the suitability of the procedures or the circuit suggestions described for the relevant application.

3.3.3 Installation instructions and notes for low voltage terminals

WARNING: Dangerous contact voltage

Please note that there are dangerous contact voltages when switching circuits that do meet SELV requirements.

Connecting and disconnecting the terminals for the 120 V AC and 230 V AC voltage areas is only permitted if the power supply is disconnected.

When working on the terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

WARNING: Dangerous contact voltage in the event of ground faults
(e.g., because the FI circuit breaker has not tripped or the star point connection is "free")

Inline terminals for the 120 V AC and 230 V AC voltage areas should only be operated in grounded AC voltage networks (AC networks).

3.3.3.1 Structure of a 120 V AC/230 V AC area

A 120 V AC/230 V AC area **must** have a power terminal at one end and an end terminal at the other.

I/O terminals for these voltage areas can be used between these terminals. The number of terminals is limited by the system limits of the bus system and the Inline system (see Section 11, “Inline Modular IO: Technical data and ordering data”).

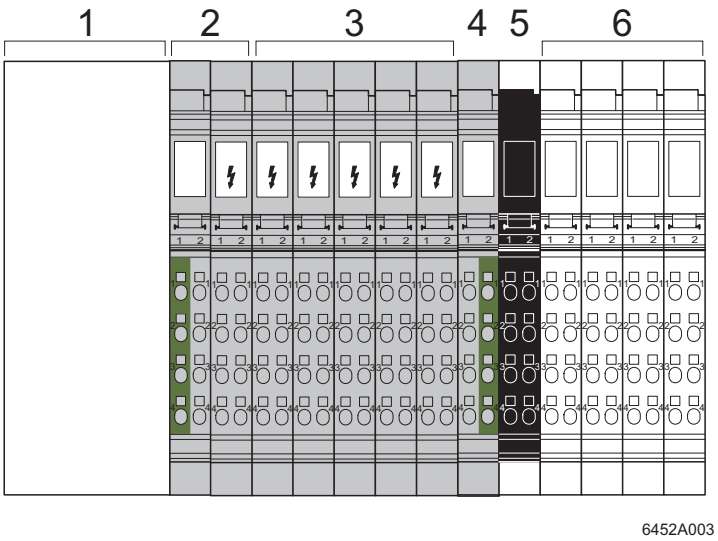

Figure 3-1 Typical structure of an Inline station with different voltage areas

1 Bus coupler
2 Power terminal for the 120 V AC or 230 V AC area
3 Various I/O terminals for the 120 V AC or 230 V AC area
4 End terminal for the 120 V AC or 230 V AC area
5 Power terminal for the 24 V DC area
6 Various I/O terminals for the 24 V DC area

3.3.3.2 Fuse protection for a 120 V AC/230 V AC area

Each 120 V AC/230 V AC area must be protected by its own external fuse. Select the rating of the fuse according to the strength of the cable. The maximum fuse value is 8 A. For additional restrictions, please refer to the data sheets for the power terminals.

3.3.3.3 Connecting the power supply and I/O in the 120 V AC/230 V AC area

WARNING: Dangerous contact voltage

The supply voltage must **only** be provided at the appropriate power terminal.

If you provided voltage to several places in an incomplete Inline station, there would be a danger of touching live parts.

The connecting cables of all actuators and sensors must only be connected to the Inline terminals for the relevant voltage area. The use of external bus bars for group potentials is **not permitted**.

3.3.3.4 Interrupting PE jumpering in the 120 V AC/230 V AC area

The PE jumper begins at the power terminal of the 120 V AC/230 V AC area and, in a complete AC voltage area, ends at the end terminal.

If a terminal is removed from this area, the PE jumper is interrupted.

If the installation instructions have been followed, all subsequent terminals will be disconnected.

3.3.4 Electronics base and connectors for the different voltage areas

Power-level terminals are located in a power housing.

Low-level signal terminals and low voltage terminals are located in the same type of housing, which is referred to as low-level signal housing. An external feature that distinguishes the base and the corresponding connectors of low voltage terminals from the base and connectors of low-level signal terminals is their color:

Table 3-2 Base and connector colors for the different voltage areas

Area	Terminal	Connector	Other differences
Low-level signal (24 V DC)	Green	Green or black	Light color for function identification (e.g., light blue)
Low voltage (120 V AC/ 230 V AC)	Gray	Gray	Dark color for function identification (e.g., dark blue) with white lightning bolt

3.3.5 Safety mechanisms to prevent incorrect connection of terminals for different voltage areas

3.3.5.1 Protection against the insertion of 24 V DC terminals and power-level terminals in the 120 V AC/230 V AC area

Low-level signal terminals and power-level terminals cannot be snaped-on within a low voltage area because there is no keyway on the right-hand side of the low voltage terminals (120 V AC/230 V AC).

WARNING: Dangerous contact voltage

The power terminals for the 24 V DC area can be inserted in a 120 V AC/230 V AC area. The minimum isolating distance in this case is the distance between two adjacent connectors. This isolating distance is not permitted. Therefore, only use end terminals that are designed for terminating the 120 V AC/230 V AC area.

3.3.5.2 Protection against the connection of 24 V connectors to 120 V AC/230 V AC terminals

The two terminal points for the low voltage I/O terminals are closed using filler plugs. The connectors for low-level signal terminals therefore do not fit on the low voltage terminals.

Exception 1: The low-level signal connectors can be plugged into 120 V AC/230 V AC power terminals.

This connection error has no hazardous effect on the electrical components, but it can lead to system malfunctions.

Only the appropriate connectors should therefore be plugged into the low voltage power terminals.

Exception 2: The low-level signal connectors can be plugged into relay terminals. Because the relay outputs are floating, this connection error has no adverse effects.

3.3.5.3 Protection against the connection of live 120 V AC/230 V AC connectors in the 24 V DC area

If the connectors for the I/O terminals are wired according to the installation instructions, they are disconnected from the power supply when removed.

The following connectors may be live in the low voltage area:

1 Connectors of the power terminals for the 120 V AC and 230 V AC areas

2 Connectors for relay terminals

These connectors are closed using filler plugs in some places and therefore do not fit on the terminals of the 24 V area.

3.3.6 Response to the connection of a 120 V AC or 230 V AC terminal in the 24 V DC area

An AC terminal can be inserted in the 24 V DC area. The effects are described in Table 3-3.

A 24 V DC terminal cannot be inserted accidentally in an AC area as these terminals are not mechanically compatible.

Table 3-3 Response to the connection of an AC terminal in the 24 V DC area

AC terminal in the 24 V DC area	Effect/description
AC power terminal in the 24 V DC area	Specified interface between a 24 V DC area and an AC area. The AC power terminal consists of two function parts: – The left-hand part interrupts the jumpering of U_S, U_M, GND, and FE – The connections for the power supply and the jumper contacts for L, N, and PE are on the right-hand part
Digital AC output terminal in the 24 V DC area	No direct danger to people. If the output is activated, the Triac output may be forced to trip and no longer switch off because the supply voltage does not pass through zero. **NOTE: Possible malfunction** This is likely to be caused by a malfunction of the actuator connected to the relevant output.
Digital AC input terminal in the 24 V DC area	No danger to people or machines. The input does not function due to missing ground.
Relay terminal in the 24 V DC area	No direct danger to people. The module has no diagonal routing, so there is no direct danger from the terminal, even with a 230 V connector. This means that the shortest isolating distance is the distance from one connector to the next. This isolating distance is not permitted. Therefore, insert a distance terminal (order designation IB IL DOR LV-SET) before and after the relay terminal.
AC end terminal in the 24 V DC area	No danger to people or machines. The terminal offers neither diagonal routing nor connector connection.

4 Inline product groups

The following sections provide an overview of the Inline product groups. For specific information about the individual terminals/modules, please refer to the specific data sheets and the individual sections in this manual.

The product range is continuously growing. Additional information can be found in the latest catalog or on the Internet at phoenixcontact.net/products.

4.1 Supported bus systems

Inline devices are available for the following bus systems:

Table 4-1 Bus systems supported by Inline

Bus system	Inline Modular IO	Inline Block IO
PROFINET IO	Yes	Yes
INTERBUS	Yes	Yes
PROFIBUS DP	Yes	Yes
Ethernet/IP™	Yes	Not at present
Ethernet TCP/IP	Yes	Yes
Modbus/TCP	Yes	Yes
Modbus/RTU	Yes	Not at present
Sercos II	Yes	Not at present
Sercos III	Yes	Yes
DeviceNet™	Yes	Yes
CANopen®	Yes	Yes
Mechatrolink	Yes	Not at present
Bluetooth	Not at present	Yes

4.2 Inline Modular IO terminals

4.2.1 Versions

4.2.1.1 Extreme conditions version (IB IL ... -XC-PAC)

Thanks to special engineering measures and tests as well as coated PCBs, the XC modules can be used under extreme ambient conditions.

For use in the extended temperature range from -40°C to +70°C, please observe Section "Tested successfully: use under extreme ambient conditions", and the notes in the terminal-specific data sheet.

The function of an XC version is the same as the function of the corresponding standard version.

Tested successfully: Use under extreme ambient conditions

XC terminals have been tested successfully over 250 temperature change cycles in accordance with IEC 61131-2 in the range from -40°C to +70°C.

The following conditions were observed:

– The Inline devices for all connecting cables were connected with a minimum conductor cross section of 0.5 mm²
– The Inline station was assembled on a wall-mounted horizontal DIN rail
– Fans were used to ensure continuous movement of air in the control cabinet
– The Inline station was not exposed to vibration or shock
– The Inline station was operated with a maximum of 24.5 V (ensured by using regulated power supply units)

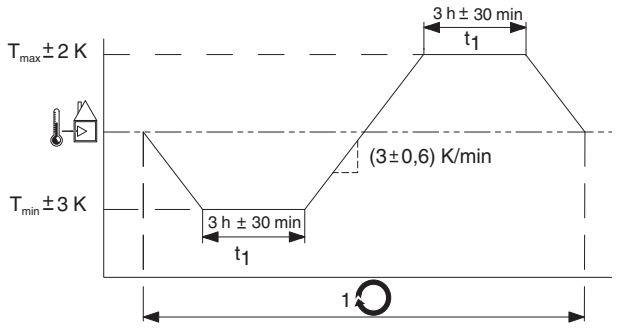

Figure 2 Temperature change cycle

Temperature in the control cabinet/ambient temperature

Cycle

WARNING:
The terminal is not approved for use in potentially explosive areas.
The terminal is not approved for use in safety technology.

4.2.1.3 ECO version (IB IL ...-ECO)

ECO version

Inline ECO terminals enhance the Inline portfolio by inexpensive and especially simple terminals providing basic functionality. You can recognize these terminals by the “ECO” specified in the order designation. You can install Inline ECO terminals in series behind Inline bus couplers or Inline controllers, and combine them with standard terminals. Please note that if an Inline ECO terminal is used, the permissible ambient temperature for the station is limited to 0 °C to 55 °C.

Features of Inline ECO terminals

- No parameterization required (for digital and analog input and output terminals)
- Limited temperature range for operation: 0 °C ... 55 °C
- Scope of supply: electronics base and required connectors
  - Analog and function terminals come without shield plug.
    For notes on shielding, please refer to Section “Connecting cables using Inline connectors” on page 123.
  - Labeling fields are not included.
    For ordering data for labeling fields, please refer to the Section “Ordering data for accessories” on page 153.

4.2.2 Scope of supply

Depending on the type, Inline terminals are available with varying accessories. Type “-PAC” and “-ME” Inline terminals come with:

- The electronics base,
- all required Inline connectors, and
- all required labeling fields.

Inline connectors are designed for connecting the cables. They are required for correct operation of the terminal.

Labeling fields are used for clear marking. They are optional accessories.

In the past, Inline terminals were available as stand-alone items without accessories. For a stand-alone item without accessories, the Inline connectors have to be ordered separately.

If your item comes without labeling field, you can separately order labeling fields as optional accessories.

Table 4-1 Scope of supply for Inline terminals, depending on the type

Type (example)	Connector	Labeling field
IB IL 24 DO 4-PAC	included in scope of supply	included in scope of supply
IB IL 24 DO 4-ME	included in scope of supply	included in scope of supply
IB IL 24 DO 4/EF-ECO	included in scope of supply	accessories (optional)
IB IL 24 PWR IN	accessories (required)	accessories (optional)