Refrigeration and Air-conditioning Technology

Climate change, the greenhouse effect and global warming – in the 21st Century there is scarcely any other subject that is more ubiquitous or “hotly” debated. Global environmental accords like the international Kyoto protocol or specifically the European directive on fluorinated gases are devoted to the problems associated with greenhouse relevant agents and the search for solutions on a political level. Refrigeration and air-conditioning applications amplify the effects of global warming.

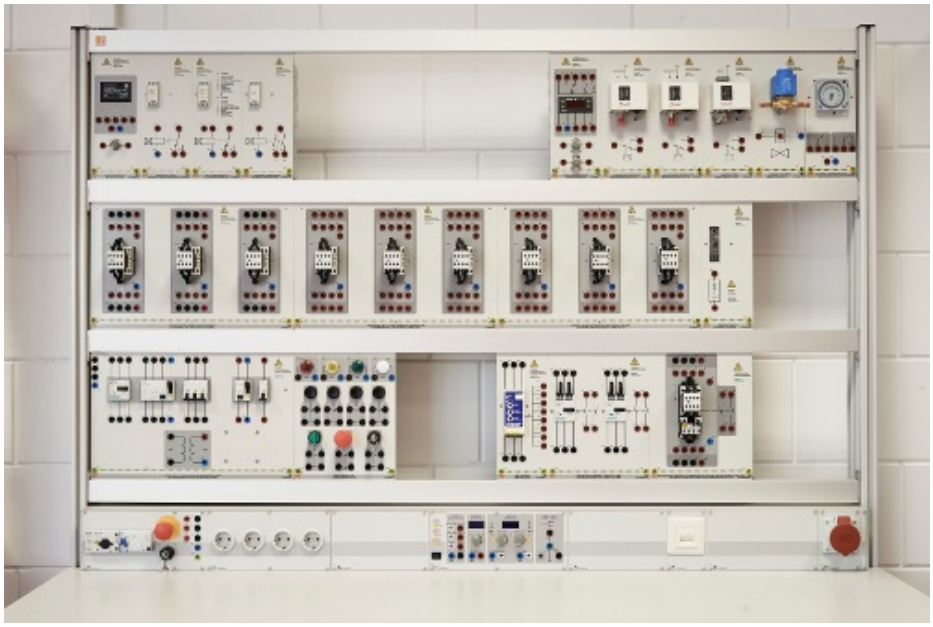
In the first place they contribute directly and in a big way to the greenhouse effect through the emission of coolants containing fluorine like partially or wholly fluorinated hydrocarbons. One example of how these emissions are caused is because of leaks in refrigeration systems which allow coolants to escape into the atmosphere. Secondly, the operation of refrigeration systems also causes additional, indirect CO_2 emissions due to the not inconsiderable amount of energy required for their operation. This problem is compounded by the fact that demand for refrigeration systems is constantly increasing.
Lucas-Nülle has committed itself to this subject and developed a concept to integrate easily serviceable and effective training systems devoted to this growing sector. Refrigeration and air-conditioning technology is a professional area that builds entirely the latest educational and technical know-how. It is the many years of experience that Lucas-Nülle has accumulated combining theoretical know-how with practical applications which empowers course participants to boost their skills and competence in this area.

Open- and closed-loop control in refrigeration and air-conditioning systems

Open- and closed-loop control in refrigeration and air-conditioning systems

This set is designed for training in the fundamentals of process control systems for refrigeration and air-conditioning systems. Trainees, student professionals and technicians from refrigeration and air-conditioning companies with training related to their profession are guided step by step through open- and closed-loop control techniques as used in refrigeration and air-conditioning and acquire a high-quality grounding for their work in the future. The combination of theory and practice ensures they get solid training.

RCC11 Open- and closed-loop control



RCC11 Open- and closed-loop control

Anyone wishing to work in refrigeration or air-conditioning needs to know all about the many electrical and control components, as well as the systems themselves. The course teaches aspects of electrical engineering, open- and closed-loop control, as well as some drive technology in a way that is practical and specific to refrigeration and air-conditioning.

Standards specifically applicable to the circuits used in construction of refrigeration systems are observed and the relevance to common practice is underpinned by using technical documentation from a variety of manufacturers.

The following training contents are covered:

- Generating a control voltage
- Circuits with primary and auxiliary contactors
- Circuits with time-delay relays
- Thermostats and pressures switches in contact control systems
- Safety chain for refrigeration and air-conditioning control systems

Basic equipment set, consisting of:

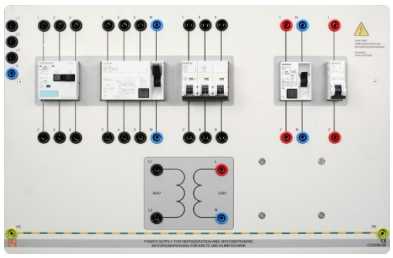
Switches and buttons for contactor controls CO3209-1K 1

Universal switch unit with all the necessary switches, buttons and indicator lights for switching small-scale control systems and contactor circuits (230V)

- 1 Emergency shut-down button, 2 x normally closed contacts
- 4 Push-buttons, 1NO/1NC contact, black
- 1 Manual-automatic switch
- 1 Manual-automatic key switch
- 1 Indicator light, red, 230VDC
- 1 Indicator light, green 230V DC
- 1 Indicator light, yellow, 230V DC
- 1 Indicator light, white, 230VDC
- Nominal voltage 230V DC
- Inputs and outputs via 4-mm safety sockets
- Dimensions: 297 x 224 x 160mm
- Weight: 1.0kg

Mains feed for heating control with control transformer, type-B RCD, 1/3-pole ci

CO3209-5B 1

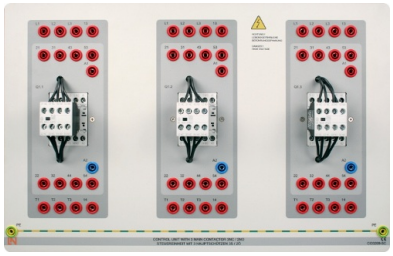


To provide power for heating and air conditioning control systems .

- Feed via CEE plug 400V/16A
- Control transformer 400/230V
- Motor protection switch, 0.7 ... 1.0 A
- Type-B RCD, 30 mA, 4-pole
- Type-ARCD, 30 mA, 2-pole
- Line circuit breaker, single pole
- Line circuit breaker, three pole
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 456 x 160mm
- Weight: 7.3kg

Control unit with 3 primary contactors and auxiliary contacts

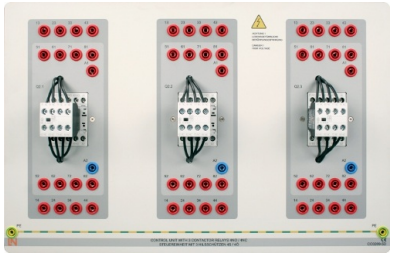
CO3209-5C 1



Control unit for assembling contactor control systems for heating and air conditioning

- 3 Primary contactors
- 3 Auxiliary contacts
- 54 x 4-mm safety sockets
- Nominal voltage 230 V/50 Hz
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 456 x 100mm
- Weight: 3.3kg

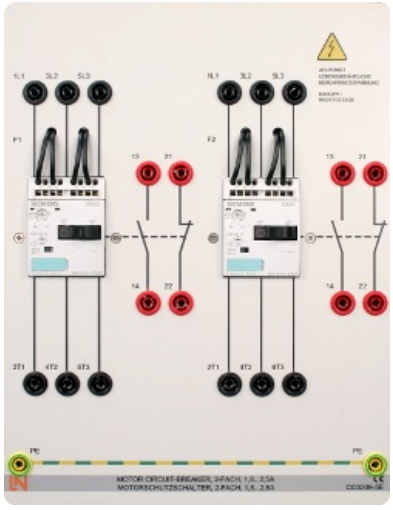
Control unit with 3 auxiliary contactors and auxiliary contacts CO3209-5D 2



Control unit for assembling contactor control systems for heating and air conditioning

- 3 Auxiliary relays (4 NO)
- 3 Auxiliary contacts (4NC)
- 54 x 4-mm safety sockets
- Nominal voltage 230 V/50 Hz
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 456 x 160mm
- Weight: 3.3kg

Motor protection switches, pair, for partially wound motor, 1.8...2.5A CO3209-5E 1

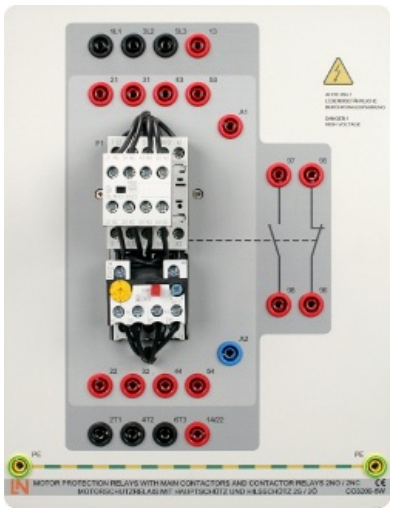


For the assembly of effective motor protection for partially wound motors

- Motor protection switch, 1.0 ... 1.5 A
- Motor protection switch, 1.5 ... 2.5 A
- 2 Auxiliary contacts (1NO, 1 NC) per switch
- 20 x 4mm safety sockets
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 224 x 60mm
- Weight: 2.3kg

Motor protection relay with primary contactor and auxiliary contacts, 2NO/2NC

CO3209-5W 1

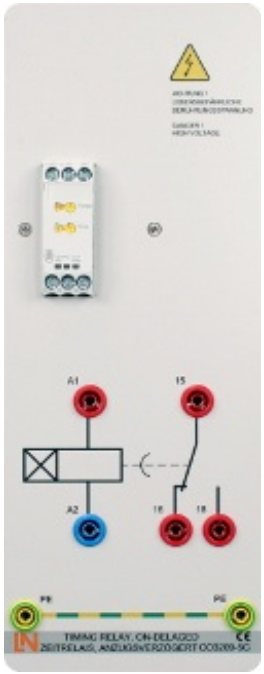


Three-pole electro-mechanical motor protection relay with bimetallic and primary contactors for monitoring and shutting down DC or AC motors. An auxiliary switch block with 2 normally-open and 2 normally-closed switches is also included. The tripping current is adjusted by means of a current-setting dial to the nominal current of the respective motor. The motor protection relay is also sensitive to faults on individual phases. An additional test button can be used to check the functionality of the auxiliary contacts.

- ZB12-4 motor protection relay
- Primary contactor
- Auxiliary switch block with 2 NO and 2 NC contacts
- Nominal voltage 230V, 50Hz
- Adjustable tripping current: 2.4 A to 4 A
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 228 x 60mm
- Weight: 1.2kg

Pick-up delayed relay

CO3209-5G 1



Delayed start-up is one of the most important time-dependence functions. The job is accomplished by time-delay relays, for which there is a large selection of time ranges

- Time range: 0.05s....100h
- Operating voltage: multi-functional 24...230VAC/DC
- Frequency: 50/60Hz
- LED function display
- Control contact: 1 change-over contact
- 10 Time ranges with fine adjustment for time
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg

Static time-delay relay CO3209-5H 1

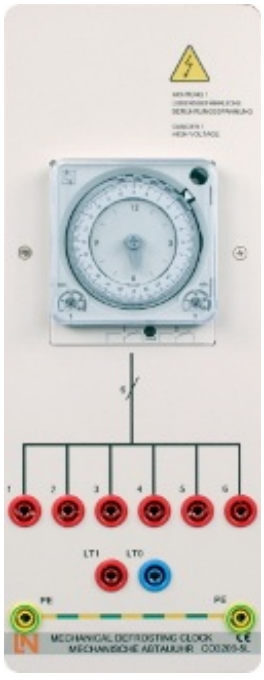
This is a special time-delay relay with memory capability, which is very good for series applications. The relays are non-contacting and can be directly connected with other contactors or actuators in series.

- Time range: 0.3s....30s
- Operating voltage: multi-functional 24...230VAC/DC
- Frequency: 50/60Hz
- LED function display
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg

Mechanical defrost timer, 2 channel CO3209-5L 1

Mechanical, analogue, dual-channel defrost switching timer with 24 hour dial and adjustable short-period programs

- Switch timer driven by synchronous motor
- Operating voltage 230 V, 50 Hz
- 2 Change-over switches 250 V/50 Hz, 16 AAC
- Mains synchronised timing precision
- Switching step 30 mins
- Switching accuracy +/- 5 mins
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg



Room thermostat for heating and air conditioning CO3209-5N 1

Electro-mechanical temperature controller with single-pole change-over switch (SPDT). The thermostat can be connected directly to single-phase AC motors, up to 2 kW, or can form part of a control circuit for either AC or DC motors

- KP69 thermostat
- Relay: change-over contact, 400V, 10A
- Temperature sensor with type-B characteristic
- Temperature range -5.....+35°C
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg

High-pressure switch for heating circuit CO3209-5P 1

Pressure switch for protecting a heating circuit against insufficient suction or for providing a high-pressure cut-off for compressors in air conditioning systems. Pressure switches are also used for controlling compressors and fans ventilating air-cooled capacitors. They include a single-pole change-over contact which can be adjusted to respond to given pressures at the connector.

- Type KP7/W pressure switch
- Includes damage-proof corrugated tubing
- Adjustment range 8....32 bars
- Relay: change-over contact, 400V, 16A
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg

Low-pressure switch for heating circuit CO3209-5Q 1

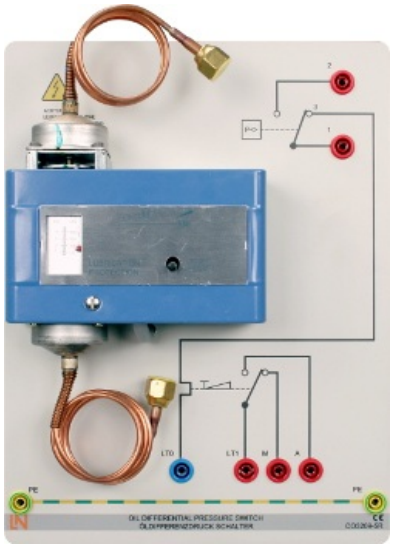
Pressure switch for protecting a heating circuit against insufficient suction or for providing a high-pressure cut-off for compressors in air conditioning systems. Pressure switches are also used for controlling compressors and fans ventilating air-cooled capacitors. They include a single-pole change-over contact which can be adjusted to respond to given pressures at the connector.

- Type KP1 pressure switch
- Relay: change-over contact, 400V, 16A
- Includes damage-proof corrugated tubing
- Adjustment range –0.2....7.5 bars
- Differential pressure 0.7...4 bars
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg

Oil differential pressure switch for oil circuit CO3209-5R 1

For protecting cooling compressors against impermissible pressures. A built-in delay switch prevents cut-off due to short-term pressure drops.

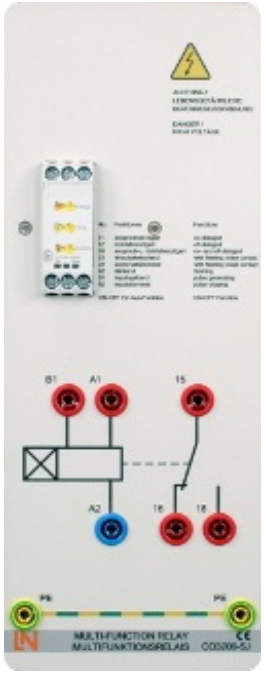
- Type P28 DP-9680 differential pressure switch
- Time-delay relay, change-over contact, 230V
- Relay, change-over contact, 230V
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 228 x 60mm
- Weight: 1.3kg



Multi-function time-delay relay CO3209-5J 1

Multi-function relays can be used in a variety of ways without the need for rewiring to alter the function.

- Time range: 0.05s....100h
- Operating voltage: multi-functional 24...230VAC/DC
- Frequency: 50/60Hz
- LED function display
- Control contact: 1 change-over contact
- 7 Time ranges with fine time adjustment
- Function selector switch for the following functions:
  Drop-in/pull-out delay
  On/off pulses
  Flashing on start of pulse
  Pulse generation
  Pulse shaping
  On-off function
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8kg



Full protection for motor, adjustable, includes additional 10K potentiometer CO3209-5M 1

Full motor protection equipment with PTC trigger and motor temperature simulator. When the PTC resistance is high enough, the external motor contactor is turned off via the relay output.

- INT69 trigger
- 9 Independent PTC inputs
- PTC/temperature simulation via 10-kohm potentiometer
- Relay output: change-over contact 250 V, 6 A, 300 VA ind.
- Inputs and outputs: 4mm safety sockets
- Dimensions: 297 x 114 x 60mm
- Weight: 1.8kg

Three-phase asynchronous motor, 1kW n=1400 (230V/400V) SE2673-1H 1

Three-phase asynchronous machine industrial model with pronounced pull-out torque

- Nominal voltage: 400/230V, 50 Hz
- Nominal current: 2.4/4.155A
- Nominal speed: 1410rpm
- Nominal power: 1kW
- cos phi: 0.74
- Dimensions: 380 x 220 x 250mm (HxWxD)
- Weight: 14kg

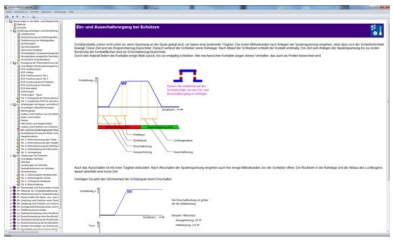
Shaft end guard, 1kW SE2662-6C 1

Attachable metal guard used to protect against accidental physical contact with machine's rotating shafts.

- Material: black steel plate, folded, closed at the sides with drilled panel and function plug
- Dimensions: 140 x 75 x 40mm (HxWxD)
- Weight: 0.18kg

Media:

Interactive Lab Assistant: Open- and closed-loop control of refrigeration and air-conditioning systems SO2801-1A 1

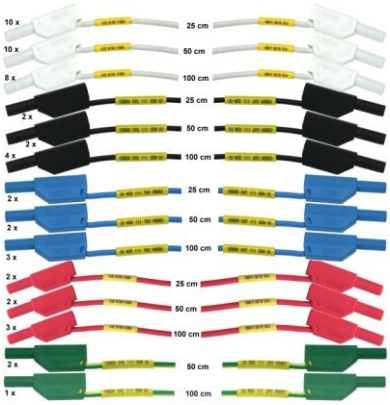


Multimedia experiment software with virtual instruments, instructions and documentation of results for controllers in refrigeration technology

- Interactive experiment set-up
- Measurements and graphics can be copied via drag-and-drop into the experiment instruction pages
- Questions with feedback and evaluation logic for testing knowledge
- Printable document so that experiment instructions with answers can be printed easily
- CD-ROM with Labsoft browser and course software

Accessories:

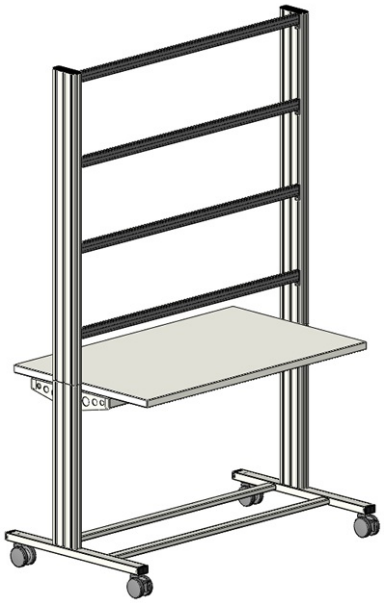
Set of safety measurement cables, 4mm (53 leads) SO5148-1B 1



Set of safety measurement leads with stackable 4 mm laminated plugs and highly flexible, double insulated wires, consisting of the following:

- 10 Safety measurement leads, 4mm, 25cm, white
- 2 Safety measurement leads, 4mm, 25cm, black
- 2 Safety measurement leads, 4mm, 25cm, blue
- 2 Safety measurement leads, 4mm, 25cm, red
- 10 Safety measurement leads, 4mm, 50cm, white
- 2 Safety measurement leads, 4mm, 50cm, black
- 2 Safety measurement leads, 4mm, 50cm, blue
- 2 Safety measurement leads, 4mm, 50cm, red
- 8 Safety measurement leads, 4mm, 100cm, white
- 4 Safety measurement leads, 4mm, 100cm, black
- 3 Safety measurement leads, 4mm, 100cm, red
- 3 Safety measurement leads, 4mm, 100cm, blue
- 2 Safety measurement leads, 4mm, 100cm, yellow/green
- 1 Safety measurement lead, 4mm, 50cm, yellow/green
- Wire cross section 2.5 mm^2
- Rating: 600V, CAT II, 32A

Mobile aluminium experiment stand, 3 levels, power strip with 6 sockets, 1250x700x1995mm ST7200-3A 1



High-quality, mobile experiments stand from the SybaPro range for demonstrations and experiments. Features aluminium profile legs compatible with all add-ons and extensions for the SybaPro system.
The mobile experiment stand is supplied in kit form and needs to be assembled by customers themselves.

Table top:

- 30-mm table top made of highly compressed, multi-layer fine chipboard conforming to DIN EN 438-1
- Colour grey, RAL 7035, with 0.8-mm slightly textured laminate coating (Resopal) on both sides, conforming to DIN 16926
- Resistant to many chemicals and reagents including dilute acids and alkalis
- Resistant to heat, e.g. molten solder or heating at specific points such as by soldering tips or cigarette ends
- Table top with solid impact-resistant protective edging made of 3mm thick RAL 7047 coloured plastic
- Coating and adhesive are PVC free
- Power strip with 6 outlet sockets mounted underneath the table top, lead and earthed plug

Frame:

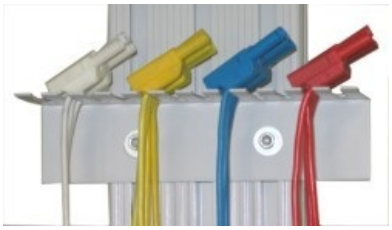
- 2 extruded aluminium profiles with multiple grooves 1800 x 120 x 40 mm (WxHxD)
- 8 equally sized grooves in extruded aluminium profiles (3 on each side and 1 each on the front and back)
- Grooves accommodate standard industrial mountings
- 4 H-shaped aluminium profiles, 1150 mm, for 3-layer organisation of DIN A4 panels
- Space for extension of power supply duct
- Base made of rectangular tubing with 4 swivelling double casters, 2 of which have brakes
- Table frame made of tough combination of rectangular tubing around the full perimeter
- Acid-resistant epoxy-resin coating, 80 µm thick (approx.), colour RAL 7047

Dimensions:

- Height of table top 760 mm
- 1250 x 1995 x 700 mm (WxHxD)

Optional Accessories:

Wall or aluminium-profile mounting cable storage for 48 cables ST8003-8E 1



Accommodates about 48 safety measuring leads (4mm), suitable for mounting on walls or aluminium profiles

- Width 200 mm, 12 guide grooves for leads
- Adjustable height for mounting on aluminium profiles
- Can be mounted on the left or right
- Can be mounted on walls
- Includes 2 screws and tenon blocks
- Acid-resistant epoxy-resin powder coating, thickness 80 µm approx., colour RAL 7047

Monitor holder for flat screen monitor of weight up to 15kg,VESA 75/100 ST8010-4T 1

Pivoting monitor holder for attachment to aluminium profiles of furniture in the SybaPro range. Allows a monitor to be placed in the optimum position so that work and experiments are less tiring.

- Pivoting arm with two-part joint
- Quick-lock for adjustment to any height on extruded aluminium profile
- VESA fastening 7.5 x 7.5cm
- Includes VESA 75 (7.5x7.5) - VESA 100 (10x10) adapter
- 2 Cable clips
- Adequate carrying capacity 15kg
- TFT monitor can be turned parallel to the table edge
- Separation can be adjusted to anywhere between 105 and 480mm

Additionally included:

Cable management set for installing cables along the profiles of the aluminium lab system furniture in the SybaPro range

The set consists of the following:

- 3 Cross cable binders for front and rear grooves of aluminium profile
- 3 Cross cable binders for side grooves of aluminium profile
- 12 Cable binders
- 4 Aluminium cover profiles for covering and enabling wires to be run along the grooves of an aluminium profile