

Physik

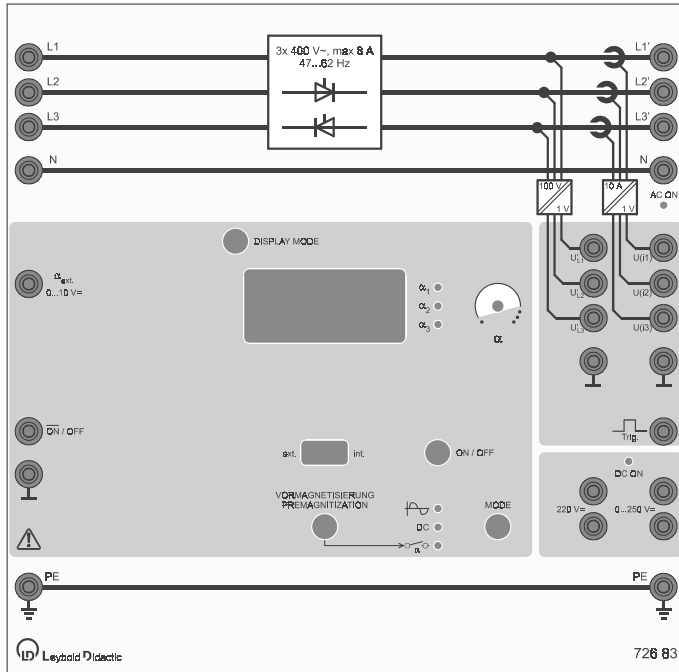
Chemie · Biologie

Technik



Leybold Didactic GmbH
Lehr- und Didaktiksysteme

03/04-W00-Hh



Instruction Sheet 726 83

Voltage Controller 3 x 400 V

Safety instructions

The training panel is designed to comply with safety class I and corresponds to the safety stipulations set forth under EN 61010. When the device is operated as directed, safe operation is guaranteed. However, safety cannot be guaranteed if the device is operated improperly or handled without the appropriate care.

- Contact-hazardous voltages are present at the sockets L1, L2, L3 and N, L1', L2', L3' and N' as well as the output for excitation and the DC power supply output. This voltage is not electrically isolated from the mains. Consequently, the electronic switches may only be operated by persons who are in a position to identify contact-hazardous voltages to take the appropriate measures / safety precautions. They are to be considered contact-hazardous even in the OFF state!
- Connect protective earth conductor / PE to the electronic (power) switch.
- Establish the protective earth conductor / PE connection to the machine or load.
- Always use safety connecting leads in the experiment setup.
- Modifications to the experiment setup may only be carried out when the power is off.
- Only connect the oscilloscope to the measurement outputs 14 and 15.
- After the disturbance display responds, switch off the device, correct disturbance source and switch the device back on.
- Under normal circumstances the electronic switch does not have to be opened. However, if this should prove necessary, it may only be opened by a technician and under the condition that all of the connecting leads have been disconnected.
- If you assume that safe operation is no longer possible (e.g. in the case of visible damage), then the device must be switched off immediately and secured to prevent it from being accidentally put back into operation.

1 Area of application

The electronic switch (power circuit-breaker) is part of the modular vocational training system. It is used exclusively for demonstrations and student exercises.

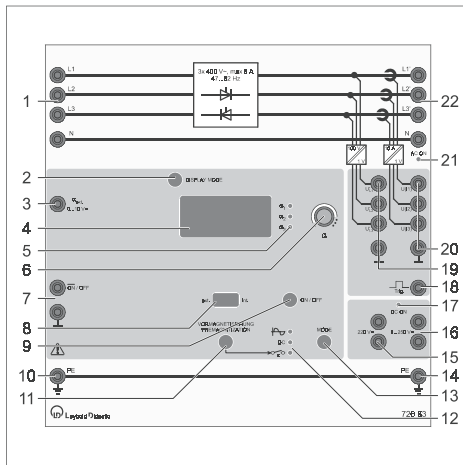
In particular electronic power circuit-breakers allow for investigations of starting operations in transformers (so-called rush effect), lines or electrical machines connected to single or three-phase AC mains.

It is also suitable for power controllers and for a DC power supply.

Operation of the training panel is only permitted in rooms approved for "instruction with experiment stands" in accordance with DIN VDE 0100 Section 723.

2 Description

The electronic switch is a microcontroller-operated thyristor switch and controller which can be operated on AC or three-phase voltage. In particular it can be used to investigate starting processes in transformers (inrush effect), lines or electrical machines. It is also suitable for power controllers and for a DC power supply.



The power component consists of a W3 circuit made up of thyristors. The control and monitoring of all functions is performed by an internal microcontroller.

The thyristor switch is protected against damage caused by external circuit elements such as shortcircuit and earth faults or overload and wrong operation. The angle setting and error messages as well as status information can be read on the display and 7 LEDs.

1 mains feed

The power switch can be operated either with single-phase AC voltage at the sockets designated L1 and N or at the sockets labelled L1, L2, L3 and N with 3-phase AC voltage. The switch tests the connected voltage and automatically switches to the correct operating mode.

The voltages required for the internal electronics are obtained from the voltage between L1 and N using the safety transformer.

- In the case of single-phase feeding only the switch-on angle α_1 of phase L1 can be set.

When the ON button (9) is activated the phase winding L1 is switched-on with a time lag amounting to the switch-on angle α_1 with respect to the voltage zero-crossover.

- For three-phase feeding with a magnetic field rotating clockwise independent switch-on angles α_1 , α_2 und α_3 can be set for all three phases. When the ON button (9) is activated, the phases L1', L2', L3' are switched on according to the three switch-on angles set.

In the case of three-phase feeding with a field rotating counter-clockwise the error message "Er0" appears in the display (4). Start up is not possible. The operator is prompted to change the rotation direction of the mains at (1).

2 DISPLAY MODE-button

This is used to switch the display between switch-on angles individually adjustable for each phase. Switchover is prevented when feeding from a single-phase mains.

3 External control input α_{ext}

Input for external controlling of the phase angle.

0 ... 10 V corresponds to 0 ... 180 °.

Not yet available on prototype panel!

4 Switch-on angle display

The three-digit 7-segment display indicates the set switch-on angle. The angle can be varied using the controller (6). Switchover between the switch-on angles α_1 , α_2 and α_3 is performed using (2) and displayed with (5).

5 LED phase display

Highlights the phase currently selected.

6 Setting knob

Used to set the switch-on angle.

7 External input and ground

With the aid of this external input switch (8) can be set to "external" so that the load can be connected by a static LOW level (< 0.8 V or switch connected with respect to ground). Disconnection of the load is performed at a level higher than 4.75 V (TTL high level) or with disconnected input. The START button is disabled when switch (8) is set to "extern".

8 ext. / int.-switch

This function is only permitted when the setting of this switch is set to the "internal" setting. Switches between internal or external ON / OFF function.

9 ON / OFF button

When the ON / OFF button is activated the load is connected to the mains and disconnected from the mains when activated again (toggle function). The operating status is displayed by the ON-LEDs (17, 21).

10 / 14 Protective earth conductor sockets

Connection terminal for the protective earth conductor. The correct functioning of the safety measures and the mains filter can only be guaranteed when the protective earth conductor is connected as stipulated.

11 PREMAGNETIZATION button

The activation of this button causes the semiconductor switch to switch briefly (during a single positive mains half-wave). This leads to a specific premagnetization, which is particularly necessary to achieve reproducible results in transformer experiments.

In three-phase operation correct premagnetization can only take place if the transformer is operated in star configuration with the neutral point connected.

12 LED display MODE

Highlights the currently selected mode.

13 MODE button

Using this MODE button it is possible to select the 3 operating modes of the electronic switch. The set operating mode is indicated by the LEDs (12).

- In the "current controller" mode the electronic switch operates as an AC or three-phase controller with adjustable phase control angles between 0° and about 120°. In three-phase operation a load can be operated in star configuration with neutral point connection.
- In the "DC" mode the electronic switch operates as a DC power supply with adjustable phase control angles between 0° and 180°. The output voltage at sockets (16) corresponds to the chosen phase angle approximately on 250 V! LED (17) is lightning when DC mode is switched on.
- In the "switch with premagnetization" setting the electronic switch operates like in "switch" mode. Furthermore, in transformer switch-on experiments, the PREMAGNETIZATION button (11) permits a predetermined positive setting of the transformer remanence. This is carried out by single positive mains half-wave switched through to the load.

15 Output sockets for 220 V-excitation voltage

Rectified mains contact-hazardous voltage to supply a DC-motor's excitation winding with nominal value of 200 V ± 10 %. Remaining voltage not switched off by the ON / OFF button (9)!

16 DC power supply-output sockets

DC output voltage controlled by the settings of phase angle. The output voltage at sockets corresponds to the chosen phase angle approximately on 250 V!

17 DC ON-LED

The DC ON-LED indicates that the contact-hazardous voltage at DC output sockets is switched on.

18 Trigger output

To display the entire switch-on or starting process, a storage oscilloscope must be triggered at the right time prior to the switch-on process. To do this, a signal is applied to the trigger output, which supplies a positive edge in the zero-crossing before a phase is connected. As long as the switch is on, a static level of 5 V is applied. After switch-off the trigger output shows 0V potential.

19 Voltage measurement outputs

The measurement outputs U'L1, U'L1 and U'L3 supply electrically isolated voltages which are divided by a factor of 100 to the load. This permits safe oscilloscoping of the starting processes.

20 Current measurement outputs

The measurement outputs U(i1), U(i2) and U(i3) supply an electrically isolated reproduction of the load currents. The curve of the load currents is represented by an equivalent voltage whereby 1 V corresponds to a current of 10 A.

21 AC ON-LED

The AC ON-LED indicates that the contact-hazardous voltage at output sockets L1', L2', L3' and N is switched on.

22 Load terminal

There is a switched voltage available at the sockets designated L1', L2', L3' and N'. Any resistive, inductive or capacitive load can be connected to these sockets. Overload or short-circuit is detected and leads to automatic switch-off.

3 Error messages

Er0 Error message when the electronic switch is supplied by a magnetic field rotating counter-clockwise. The mains power

supply has to be switched off and two phase windings interchanged.

Er1 Error message for short-circuit of the switch output. The switch disconnects the load from the mains and prevents renewed switch-on. The electronic switch must be isolated from the supply voltage and can only be switched on again after the fault source has been corrected.

Er2 Error message when the maximum permissible effective current is exceeded. The switch disconnects the load from the mains and prevents renewed switch-on. After the supply voltage has been switched off and the fault corrected the electronic switch can be put back into operation.

4 Technical data

Power components

Mains connection voltage:	230 V or 3 · 230 V / 400 V,
can be refitted for	115 V or 3 · 115 V / 200 V
Mains frequency:	50 Hz (48 Hz...52 Hz) 60 Hz (58 Hz...62 Hz)
Current consumption:	max. 8 A
Internal fuse for electronics:	T 0.2
Nominal voltage:	3 x 400 V / 1 · 230 V
Nominal frequency:	48 Hz ... 62 Hz
Continuous current:	3 x 8 A
Peak current ITRM:	3 x 400 A
I ² t value:	3 x 400 A ² s

Electronic fuse, outputs are short-circuit and earth-fault proof
CE seal, integrated interference suppression filter

6 x measurement outputs

Electrical isolation; safety extra-low voltage (SELV)

1 x trigger output

Short-circuit proof

External control inputs

Back e.m.f. proof :	up to 230 V / 400 V
Output voltage U + I:	-10 V...+10 V
Output pulse trig.:	0 V/5 V
Conversion factor U:	100 / 1
Conversion factor I:	10 A / 1 V
Ext. control input ON / OFF:	0 / 5 V...24 V

5 Summarized instruction/experiment example:

Investigation of starting response of a single-phase transformer

Measuring the starting current inrush of a single-phase transformer at various switch-on angles with an oscilloscope.

The following is meant as a general example on how to proceed:

Connect the electronic switch and the oscilloscope as follows:

- Channel Y1 with socket U'_{L1} to (19)
- Channel Y2 with the socket $U_{(1)}$ to (20)
- Ext. trigger to socket (18)

Connect the transformer to the voltage controller using safety connecting leads:

- Socket L1' at the connected output (22) to the transformer's primary terminal 1.1
- Socket N' at the connected output (22) to the transformer's primary terminal 1.2
- Establish PE connection

Apply an AC mains voltage to the mains feed (1):

- Connect L1 and N
- Connect PE / protective earth conductor

Set the oscilloscope as follows:

- Activate the storage and dual channel operation
- Triggering: EXTERNAL, rising edge
- Time base: 10 ms/DIV
- Channel Y1: 2 V/DIV
- Channel Y2: 1V/DIV

Switch on the mains. After a brief initialization phase the voltage controller is operational, the seven-segment display indicates 0.

- With the MODE button (13) set the operating mode to "Switch with Premagnetization".
- Using the controller (6) set a switch-on angle of 0°
- Activate the PREMAGNETIZATION button to shift the remanence into a positive end position through premagnetization.
- Activate the ON / OFF button (9). The transformer is switched on during the voltage zero-crossover (angle of 0°). The characteristic of the current (Y1) and the voltage (Y2) is displayed on the oscilloscope (see also the following oscillograph).
- Activate the ON / OFF button (9) again. The transformer is switched off.
- For further experiments with other switch-on angles repeat the procedure outlined above.

