DN3PD1

Original Instruction Manual
valid for ID-No: 33PD02

Safety switchgear
to monitor the speed of three-phase and single-phase motors without sensor

wir sind sicherheit.

EU-Konformitätserklärung
EC-Declaration of Conformity

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Wir erklären, dass folgendes Produkt die einschlägigen Harmonisierungsrechtsvorschriften der Union erfüllt.
We declare that the following product is in conformity with the relevant Union harmonisation legislation.

Produkt/product	Beschreibung/description
DN3PD1	Sicherheitsschaltgerät zur sensorlosen Drehzahlüberwachung bei Drei- und Einphasen Motoren Safety switchgear unit to monitor the speed of 3-phases and single phase motors without sensor

EU-Richtlinien/EC- directives	Angewandte Normen/Applied standards
2006/42/EG Maschinenrichtlinie/Machinery-Directive 2014/30/EU EMV-Richtlinie/EMC-Directive 2011/65/EU RoHS Richtlinie/RoHS-Directive	EN ISO 13849-1:2015 IEC 62061:2015 IEC 61800-5-2:2016 IEC 61508: Parts 1-7:2010 EN 50178: 1997 EN 60204-1:2006 + A1:2009 + AC:2010 EN 60947-5-1:2010 EN 61326-1 :2013 EN 61326-3-1:2008 + Entwurf 2015 SIL3 GS-ET-20: 2016-10

Notifizierte Stelle/notified Body	EG Baumusterprüfbescheinigung/EC Type-Examination certificate
TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln Germany NB 0035	Reg.-Nr./No.: 01/205/5650.01/18

Wolfschlugen, 24.07.2018

Dirar Najib
Geschäftsführer/CEO

Content

Always read the additional applicable online documentation before working on/with the safety switchgear. Make sure you always work with the valid documentation. This is available online at *http://www.dina.de/downloads/*

Dispose of the device according to the national environmental regulations.

Symbol and Notes:

WARNING
Observe the safety regulations and installation notes in the corresponding section.

INFO
Observe the notes in the corresponding section.

Version overview / Change history

Version	Date	valid for ID-No	Innovations / changes
0743	2018-12-06	33PD02	

1 Intended Use

- Safety switchgear to monitor the speed of three-phase and single-phase motors without sensor.
- Two speed thresholds are possible: minimum speed and maximum speed.
- The unit meets Cat. 4/ PL e acc. to ISO 13849-1, SIL (CL) 3 acc. to IEC 62061 and IEC 61508.
- Usage in safety current circuit according to VDE 0113 T.1

1.1. Approvals

1.2. Safety parameters

The unit meets Cat. 4/ PL e and SIL (CL) 3.

Parameter	Value	Note
PFH	1,56 E-09 1/h	1,6 % von SIL 3
$MTTF_d$	553 a	HIGH
DC_{avg}	95%	(HIGH)

table 1-1: Safety parameters

1.3. Ordering data

Description		Type	ID-No.:
Speed monitoring, sensorless	0-600Hz, 2 contact outputs, start-up monitoring, switch-off time 01	DN3PD1	33PD02-01
Speed monitoring, sensorless	0-600Hz, 2 contact outputs, start-up monitoring, switch-off time 02	DN3PD1	33PD02-02

2 Safety regulations

- The device may only be installed and commissioned by an electrician or trained persons who are familiar with these operating instructions and the applicable regulations regarding work safety and accident prevention.
- Observe the VDE, EN and local regulations, particularly with respect to the protective measures.
- Failure to observe the regulations may result in death, severe bodily injury or extensive property damage.
- For emergency-stop applications, either the integrated function for restart interlock must be used or automatic restarting of the machine must be prevented by means of a higher-level control.
- During transport, storage and operation, adhere to the conditions specified in EN 60068-2-1, 2-2!
- Unauthorized modifications shall render any warranty null and void. Dangers may thereby arise that could result in severe injuries or even death.
- Install the device in a control cabinet with a protection class of at least IP54! Dust and moisture may otherwise result in impaired functions. Installation in a control cabinet is mandatory.
- Ensure adequate protection circuits at output contacts for capacitive and inductive loads!
- The device is to be installed taking into account the distances required per DIN EN 50274, VDE 0660-514.
- During operation, switching devices carry dangerous voltage. Do not remove protective covers.
- Replace the device after the first malfunction.
- Properly dispose of the device at the end of its service life.
- If these regulations are not adhered to or in the event of improper use, DINA Elektronik GmbH accepts absolutely no liability for the resulting property damages or personal injury.
- Save this product information!

3 Important information and validation

- The product described here was developed to perform safety-related functions as part of a complete system.
- The complete system consists of sensors, evaluation and message units as well as concepts for safe shutdowns.
- It is the responsibility of the manufacturer of a system or machine to ensure the proper overall function.
- The manufacturer of the system is required to test and to document the effectiveness of the implemented safety concept within the complete system.
  In this case, it must be checked whether the release contacts open when exceeding or falling below the thresholds.
- This verification is to be performed after every modification to the safety concept or to safety parameters.
- DINA Elektronik is not in the position to guarantee the properties of a complete system that was not designed by DINA.
- DINA Elektronik GmbH also accepts no liability for recommendations that are given or implied by the following description.
- No new guarantee, warranty or liability claims that extend beyond DINA's general delivery conditions can be derived on the basis of the following description.
- To avoid EMC disturbances, the physical environmental and operating conditions at the installation location of the product must comply with section EMC of DIN EN 60204-1.
- When using contact outputs, the safety function must be requested once a day at PL e and once a year at PL d according to IEC 61800-5-2.
- Observe the general technical data at the end of this operating manual.

4 Function description

The two-channel evaluation unit of the safety switchgear module measures the frequency of the effective rotating field of the motor at the measuring terminals L1, L2, L3.
If the parameterized switching threshold frequencies are exceeded or undershot (V-LIMIT 1 and V-LIMIT 2), or an internal or external fault exists, the enabling current paths 13/14, 23/24 open immediately. The device is in safe switching state.
The monitoring of V-LIMIT 1 can be deselected. Then the output contacts remain closed at standstill.
Asynchronous motors have a load-dependent slip between the motor speed and the rotating field frequency. This must be observed by the configuration of the switching threshold (V-LIMIT 1 and V-LIMIT 2).

4.1. Switching threshold

Two switching thresholds are configurable.

V-LIMIT 1: minimum speed
If V-LIMIT 1 is undershot, the output contacts (13-14 / 23-24) switch off.
They switch on again after the acknowledgment via the acknowledgment input Q.

Depending on the acknowledgment mode, the switch-on-conditions differ. Please note the chapter "Function diagram".

V-LIMIT 2: Maximum speed
If V-LIMIT 2 is exceeded, the output contacts (13-14 / 23-24) switch off.
They switch on again after the acknowledgment via the acknowledgment input Q, if V-LIMIT 2 (minus hysteresis) is undershot.
Switching on takes place at the earliest after 0.5 seconds. (see chapter minimum switch-off time)

4.2. Start-up monitoring

The startup monitoring t_A is a time limit within which the actual speed must be greater than V-LIMIT 1. If the minimum speed is not reached during this time, the enable current path opens again.
The start-up monitoring time is fixed and is 60s. It is not retriggerable, it cannot be restarted while it is running.

The start-up monitoring time starts

- In case of manual acknowledgment: with the falling edge of the acknowledge signal
- In case of automatic acknowledgment: if the actual speed is> 1Hz

The startup monitoring is omitted if V-LIMIT 1 has been deselected.

4.3. Minimum switch-off time

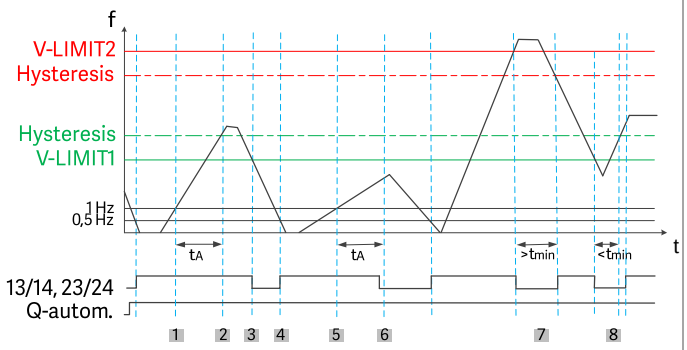
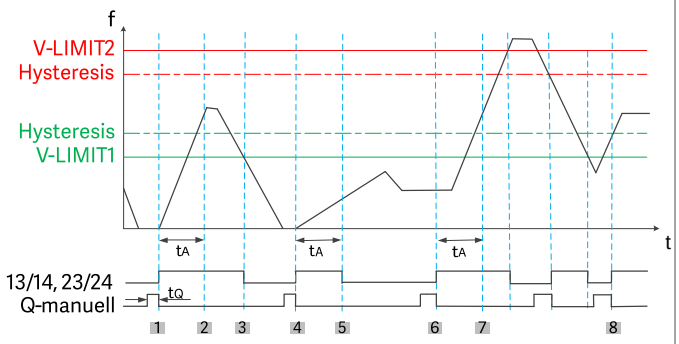
The minimum switch-off time t_{min} is the time that the enable current path is at least open after triggering before it switches on again. It is 0.5s.

4.4. Acknowledge function

- With the acknowledgment function, the enable current path is switched on again after a shutdown due to underspeed or overspeed.
- The acknowledgment takes place via the input Q.
- Automatic or manual acknowledgment is possible.
- With automatic acknowledgment, the Q input must always be connected to 24V DC.
- A manual acknowledgment takes place after a falling signal edge at the input Q ($t_Q \geq$ 200ms and $\leq$ 10s).

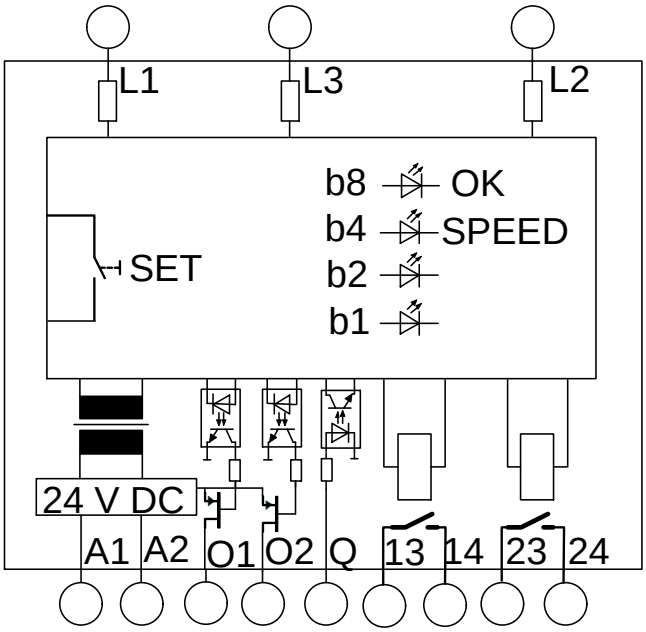
- Signal that is longer than10s does not cause a reset.
- For parameterization of the acknowledgment function see chapter " Configuration of the switching threshold and acknowledgement".

4.5. Functional diagram

Automatic acknowledgement V-LIMIT 1 and V-LIMIT 2 (V-LIMIT 1 must be at least 1.1Hz!)	Manual acknowledgment V-LIMIT 1 and V-LIMIT 2
	

1	Start-up monitoring time starts if f>1Hz	1	Start-up monitoring time starts with the falling edge of the acknowledgement signal.
2	Start-up monitoring time is expired. Enabling current path remains closed because f>V-LIMIT 1.	2	Start-up monitoring time is expired. Enabling current path remains closed because f>V-LIMIT 1.
3	Enabling current path opens because f<V-LIMIT 1.	3	Enabling current path opens because f<V-LIMIT 1.
4	Enabling current path closes, if f<0,5Hz.	4	Start-up monitoring time starts with the falling edge of the acknowledgement signal.
5	Start-up monitoring time starts if f>1Hz.	5	Start-up monitoring time is expired. Enabling current path opens because f < V-LIMIT 1.
6	Start-up monitoring time is expired. Enabling current path opens because f < V-LIMIT 1.	6	Start-up monitoring time starts again.
7	The setpoint speed was reached outside of the minimum switch-off time. Enabling current path closes.	7	Start-up monitoring time is expired. Enabling current path remains closed.
8	The setpoint speed was reached within the minimum switch-off time. Enabling current path closes after 0.5s.	8	Enabling current path closes because V-LIMIT 1<f<V-LIMIT 2.

4.6. Schematic, operating element and display



L1, L2, L3	Measuring inputs
A1	Power supply +24V DC
A2	0V
Q	Acknowledgment input
O1, O2	Diagnostics outputs
13-14/23-24	Enabling contacts
SET	Configuration button
b1, b2, b4, b8	parameter 1-15
OK	Ready for operation
SPEED	Speed Status

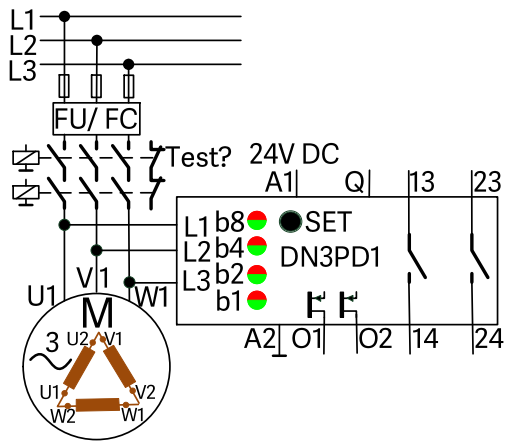
4.7. Terminal description

A1/ A2	Power supply 24V DC
L1, L2, L3	Measuring inputs are to be connected directly to the motor, without switching contacts between.
Q	Acknowledgment input can be parameterized, manually or automatically
13/14, 23/24	Enabling contacts (2 NO-contacts). These switch off immediately if the parameterized speeds are undershot or exceeded or internal or external errors. 13/14, 23/24 are to be used in such a way that the intended safety function, e.g. emergency stop is executed.
O1, O2	Digital positive switching semiconductor outputs for the transmission of switching states to a higher-level control for diagnostic tasks.

5 Applications

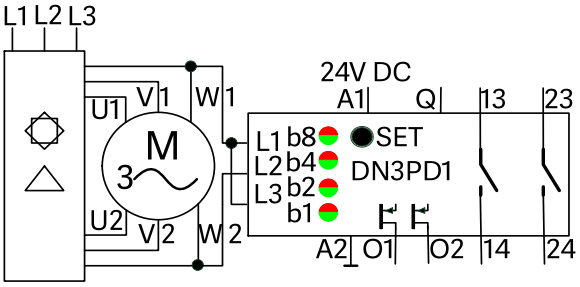
5.1. Motor with frequency converter

The operation on electric power drive systems with adjustable speed is possible. (Frequency converter)



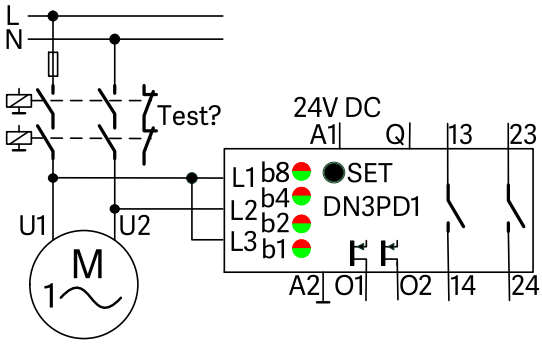
5.2. Motor with star-delta circuit

Operation on motors with star-delta connection or pole changeover is possible. For pole-changing motors, please note that DN3PD1 detects the frequency and not the speed!
The measuring inputs L1 and L3 are bridged and directly connected to W1 on the motor.
The measuring input L2 is directly connected to W2 on the motor.



5.3. Single-phase motor

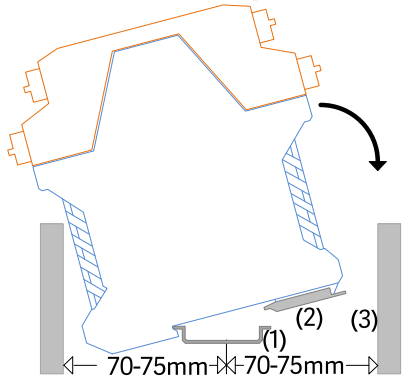
Operation on a single-phase motor is possible.
The measuring inputs L1 and L3 are bridged and directly connected to U1 on the motor.
The measuring input L2 is directly connected to U2 on the motor.



6 Mounting and removal

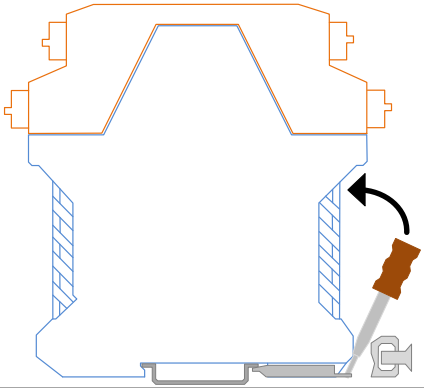
Mounting on 35mm DIN rail according to EN 60715
For the removal pull the lock device using a screwdriver
Required distances according to DIN EN 50274, VDE 0660-514 must be observed
No strong magnetic fields in the installation vicinity. (Magnetic fields < 30 A/m). These can interfere with the unit.

Mounting



(1) DIN rail
(2) lock device
(3) cable channel

Removal



6.1. Wiring

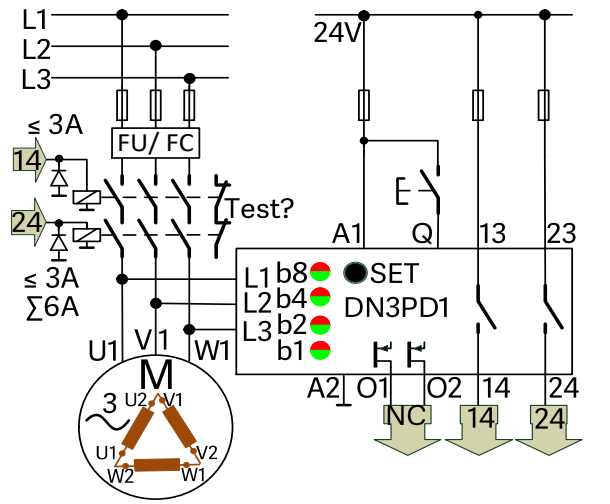
- Conductor cross-section of 1.5 mm² must not be undercut.
- Use Copper wires approved up to 60°C/75°C.
- For of wire end sleeve is recommended.
- Loads connected to the measuring wires are not allowed.
- The placing of the measuring wires has to avoid a cross connection or short. Laying in cable channel.
- The regulations according to EN 60204-1 are to be followed.
- Use effective protective circuits parallel to an inductive load to avoid a shortcut of the output contacts.
- The arrangements of the overcurrent protective mechanism are to consider.
- Overvoltage > 32V DC destroys the unit.
- Use power supply with max. 32V output voltage also with fault..

6.2. Commissioning

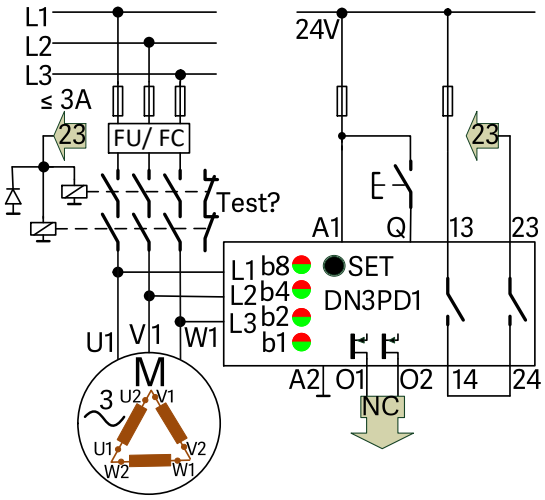
- Switch off the unit befor you start working.
- Wire the unit according to intended use
- Connect the power supply 24V DC to A1 and 0V to A2.
- Self-test follows. After faultless self-test the unit is in function. The LED OK is green

6.3. Example of application

Application: Output contacts connected in parallel



Application: Output contacts connected in series



7 Parameterization of the switching thresholds

7.1. Important notes for parameterization

- Use a VDE-insulated screwdriver according to EN 60900 to press the SET button.
- The switching threshold and acknowledgement must be set correctly in order to ensure safe operation; this responsibility lies with the user.
- To determine the switching thresholds, the number of pole pairs must be taken into account:
- f [Hz]= (n [U/min] / 60) x number of pole pairs
- Example: 5000 rev/min x 3 (number of pole pairs) / 60 = 250Hz
- During parameterization, the output contacts are switched-off.
- The parameters are not saved by voltage break or break of the parameterization for longer than 20s.
- Frequency of (V-LIMIT 2 -10%) must be higher than (V-LIMIT 1).
- On automatic acknowledgement must be V-LIMIT 1 ≥ 1,1Hz .
- The monitoring of a minimum speed can be deselected. In this case, the lowest frequency for V-LIMIT 1 should be selected. There is no distance to keep to V-LIMIT 2. The output contacts remain closed at standstill.

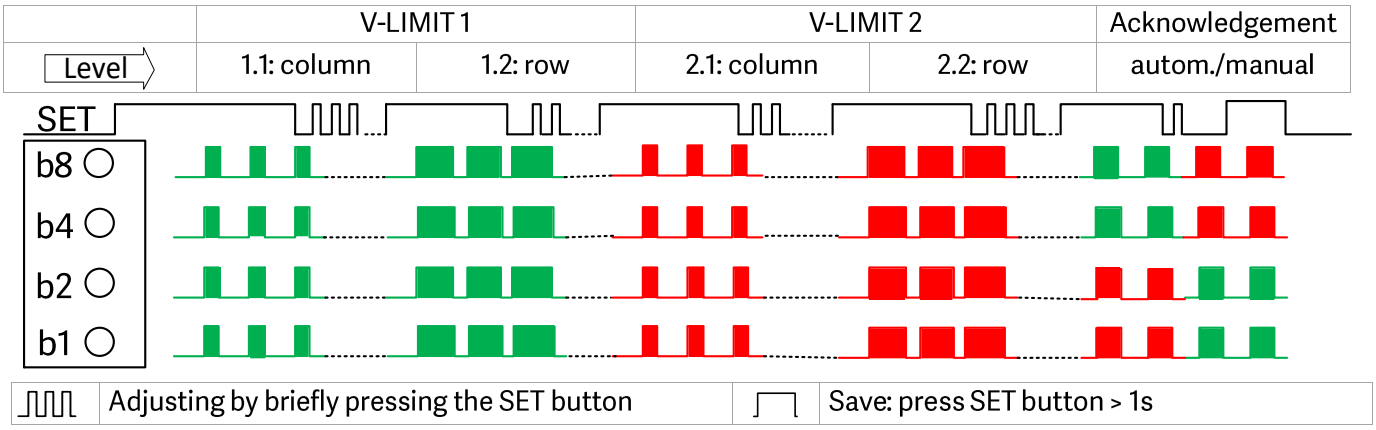
7.2. Table of frequencies

These frequencies (in Hz) can be set as switching thresholds.

		Level x.1														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Level x.2	1	0,15	1,26	1,96	3,05	4,8	7,4	11,5	18,0	28,00	43,6	68,0	104	159	255	396
	2	0,20	1,29	2,02	3,14	4,9	7,6	11,9	18,5	28,8	44,9	70,0	106	163	263	408
	3	0,30	1,33	2,08	3,24	5,04	7,9	12,2	19,1	29,70	46,3	72,1	109	167	270	418
	4	0,40	1,37	2,14	3,33	5,2	8,1	12,6	19,6	30,6	47,7	74,3	112	172	278	431
	5	0,50	1,41	2,20	3,43	5,35	8,3	13,0	20,2	31,5	49,1	76,5	116	178	287	443
	6	0,60	1,46	2,27	3,54	5,5	8,6	13,4	20,8	32,5	50,6	78,8	119	181	295	458
	7	0,70	1,50	2,34	3,64	5,7	8,8	13,8	21,5	33,4	52,1	81,1	123	187	304	471
	8	0,80	1,55	2,41	3,75	5,8	9,1	14,2	22,1	34,4	53,7	83,6	126	191	314	485
	9	0,90	1,59	2,48	3,86	6,0	9,4	14,6	22,8	35,5	55,3	86,1	130	196	323	500
	10	1,00	1,64	2,55	3,98	6,2	9,7	15,1	23,5	36,5	56,9	88,7	134	214	333	514
	11	1,05	1,69	2,63	4,10	6,4	10,0	15,5	24,2	37,6	58,6	91,3	138	221	342	529
	12	1,10	1,74	2,71	4,22	6,6	10,3	16,0	24,9	38,8	60,4	94,1	142	227	353	544
	13	1,15	1,79	2,79	4,35	6,8	10,6	16,5	25,6	39,9	62,2	97,5	147	234	363	560
	14	1,18	1,85	2,88	4,48	7,0	10,9	17,0	26,4	41,1	64,1	100	150	240	374	575
	15	1,22	1,90	2,96	4,61	7,2	11,2	17,5	27,2	42,0	66,0	102	155	247	385	594

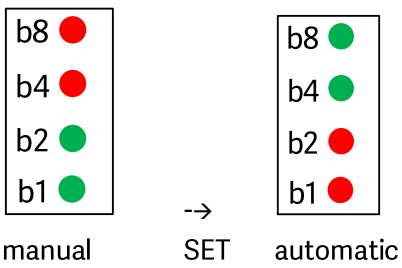
7.3. Configuration of the switching threshold and acknowledgement

The current settings can be checked by briefly pressing the SET button. The LEDs show the parameters binary coded in five steps (Level). Two levels each determine V-LIMIT 1 and V-LIMIT 2 (see frequency table), the fifth level indicates the type of acknowledgment.
The permanent pressing of the SET button starts the parameterization mode and the levels can be run through. Releasing the button allows you to change this level parameter. The configuration can be adjusted by a short touch of the button. The new setting is saved again by pressing the button permanently.
Each level can be recognized by its flashing rhythm or the LED color.



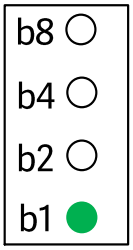
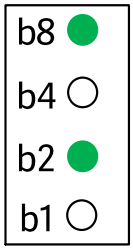
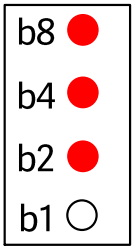
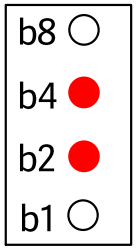
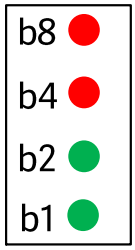
- Press SET button for >2s until all LED flash green.
- Adjust V-LIMIT 1, Level 1.1 binary coded by short key press (column of the table 7-1)
- Keep the SET button pressed: The value is saved and displayed as continuous light.
- Keep the SET button pressed until the blinking rhythm of all LEDs changes.
- Adjust V-LIMIT 1, Level 1.2 binary coded by short key press (row of the table 7-1).
- Keep the SET button pressed: The value is saved and displayed as continuous light.
- Keep the SET button pressed until the color of all LEDs changes.
- Adjust V-LIMIT 2, Level 1.1 binary coded by short key press (column of the table 7-1)
- Keep the SET button pressed: The value is saved and displayed as continuous light.
- Keep the SET button pressed until the blinking rhythm of all LEDs changes.
- Adjust V-LIMIT 2, Level 1.2 binary coded by short key press (row of the table 7-1).
- Keep the SET button pressed. The value is saved and displayed as continuous light.
- Keep the SET button pressed until the LED flash in pairs.
- Adjust the acknowledgement*) by short key press
- Keep the SET button pressed: The value is saved and displayed as continuous light.
- Release the button. The configuration is completed. The unit is ready for operation, if the OK LED shows green.

*) Adjust the acknowledgement



The set thresholds must be validated as follows:
Checking the set parameters in the display mode (short pressing of the SET key) and verification of the correct safety functions by checking the shutdown speeds, e.g. by comparison with the speed displayed on the frequency converter or use of other suitable speed measuring equipment.

7.4. Example for configuration

V-LIMIT 1 = 1,0 Hz		V-LIMIT 2 = 297,9 Hz		Acknowledgement
Level 1.1	Level 1.2	Level 2.1	Level 2.2	manual
column 1	row 10	column 14	row 6	
				

8 Diagnostics

The 2-color LEDs (b1, b2, b4, b8) indicate operational readiness, switching status, internal and external errors.
The semiconductor output O1 is switched on when the frequency is within the parameterized range. See Fig. 8-1
The semiconductor output O2 indicates the operational readiness. This switches off in case of an error.

LED OK	LED SPEED	O1	O2	13/14, 23/24	Status	
green	green	24V	24V		acknowledged	in range
green	off	0V	24V		not acknowledged	out of range
green	flashing green	0V	24V		acknowledged	out of range
green	off	24V	24V		not acknowledged	in range
flashing red	off	0V	0V		error	see error report

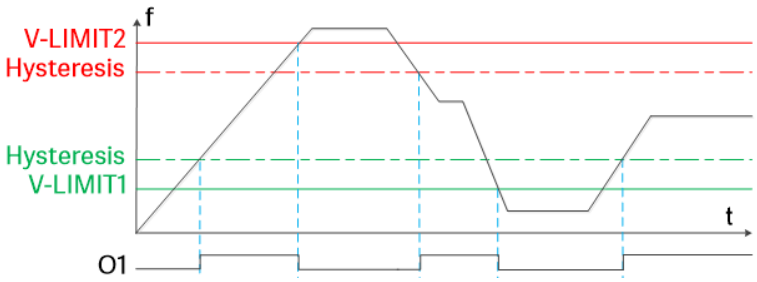


Fig. 8-1

8.1. Error report

The red flashing LED OK signals an error condition.
The flashing variations for different causes of faults are shown below.

flashing variation	possible cause	remedy
1x 1s 1x 1s 1x	incorrect power supply UB < 20V or > 32V	UB=20.5V-26,5V DC
... 2x 1s ... 2x 1s ... 2x	(V-LIMIT 2) < (V-LIMIT 1)	(V-LIMIT 2 – 10%) > (V-LIMIT 1)!
... 3x 1s ... 3x 1s ... 3x	incorrect acknowledge signal Q < 200ms or > 10s	Q ≥200ms, <10s
... 4x 1s ... 4x 1s ... 4x	open-circuit on L1, L2, L3	check on short circuit cross-connection wire break
... 5x 1s ... 5x 1s ... 5x	single-channel measuring	check on short circuit cross-connection wire break
... 6x 1s ... 6x 1s ... 6x	relay error	check on external error switch off, switch on exchange
... ≥7x 1s ... ≥7x 1s ... ≥7x	internal error	switch off, switch on exchange

9 Technical data

9.1. Ambient conditions

Ambient temperature (operation)	-20 to +55°C DIN IEC 60068-2-3
Ambient temperature (storage)	-40 to +85°C DIN IEC 60068-2-3
Maximum altitude	max. 2000m (above sea level)
Vibration resistance 3 axis	Sinus 10–55Hz, 0,35mm, 10 cycles, 1 octave/min
Air and creepage distances	DIN EN 50178, safe isolation
Protection class	Installation in a closed cabinet, min. IP54

9.2. Input data

Operating voltage UB	24V DC -15 % / +10 %, reverse protection
Current draw at 24V DC	typ. 80mA
Current draw at L1, L2, L3	0,35mA at 690V AC
Input voltage at L1, L2, L3	90 to 690V AC
Input frequency at L1, L2, L3	≤ 600 Hz
Switching hysteresis	10%
Power consumption at A1/ A2	typ. 1,9W
Status display	4 x LED 2-color
Protection wiring	Overvoltage/ inverse polarity protection

9.3. Output data

Contact type	2 enabling NO-contacts	
Contact material	$AgSnO_2$	
Operating voltage	24V DC / 230V AC	
Minimum switching current	3 mA/ 24V DC	
Maximum switching current	6A / 24V DC/ 230V AC	
Short-circuit strength	1000A SCPD 6A gL/gG	
Mechanical life	10^7 switching cycles	
Switch-off time 01	Up to 30 Hz: 1 period (reciprocal value of the set frequency) + 10ms Over 30 Hz: 3 x 1 period + 10ms	
Switch-off time 02	Up to 2,5 Hz: 1 period (reciprocal value of the set frequency) + 10ms Over 2,5 Hz: 2 x 1 period + 10ms	
Output fuse	6 A gL/gG	
B10d values acc. to DIN EN 61810-2-1, 01.2012	AC15: 5A/230V AC, >2x10^5, AC1: 6A/230V AC, >2x10^5	DC13: 4A/24V DC, >3x10^5 DC1: 6A/ 24V DC, >7x10^5 switching cycles
Total current 13-14 and 23-24	with parallel connection: 6A	with serial connection: 3A
Outputs O1, O2	≤ 100mA(UB-1V) shot-circuit and overload protection	

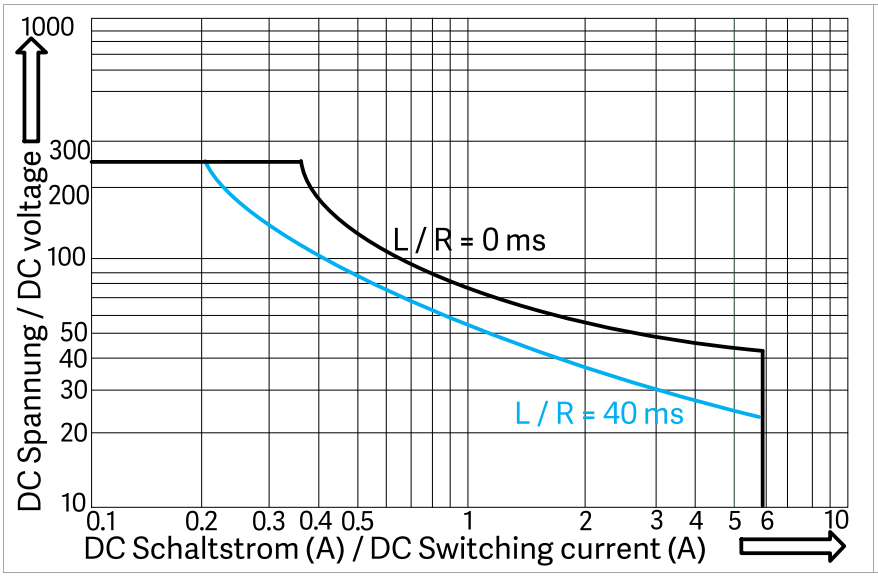
9.4. General data

Nominal operating mode	100 %
Protection class	IP20
Mounting position	vertical or horizontal
Housing material/ Type	Polyamide PA not increased/ ME/ Phoenix Contact
Dimensions	B x H x T/ 22,5 x 114 x 111 mm
Degree of pollution	2
Overvoltage category	III

9.5. Connection data

Terminals/ Material	Push-in, pluggable/ PA		Screw, pluggable /PA
Number of pins	4	5	3
Rated surge voltage	4kV	2,5kV	8kV
Rated insulation voltage	320V	160V	1000V
Conductor cross-section, flexible with wire end sleeve	0,25 - 2,5mm^2	0,25 - 1,5mm^2	0,25 - 2,5mm^2
Conductor cross section AWG	24...12	24...16	24...12
Connection wire	60/75°C Copper		
Tightening torque min/max	-	-	0,5Nm/0,6Nm

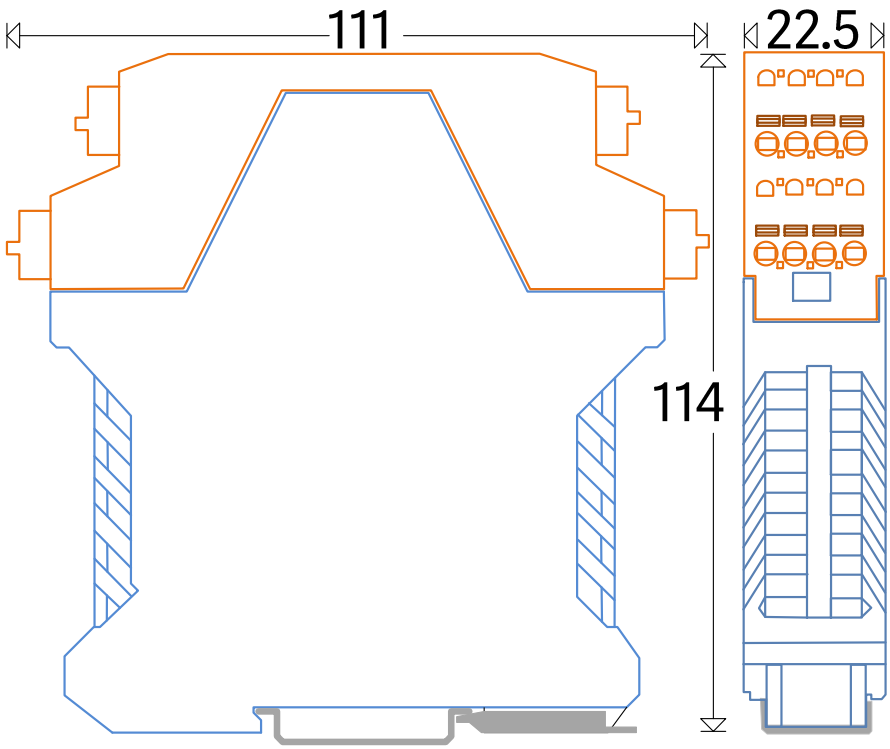
9.6. Relay load curve



ohmic load L/R = 0ms
inductive load L/R = 40ms

WARNING
Loads with high capacitive component can destroy the output contacts because the switching current is very high.

10 Dimensions



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DN3PD2

Original Instruction Manual

Safety switchgear
to monitor the speed of three-phase and single-phase motors without sensor

with
Configuration-Software GO:BEYOND

wir sind sicherheit.

EG-Konformitätserklärung
EC-Declaration of Conformity

Hersteller/manufacturer
DINA Elektronik GmbH Esslinger Str. 84 72649 Wolfschlugen Germany

Wir erklären, dass folgendes Produkt allen einschlägigen Bestimmungen der EG-Richtlinien entspricht.
We declare that the following product complies with all relevant provisions of the EC directives.

Produkt/product	Beschreibung/description
DN3PD2	Sicherheitsschaltgerät zur sensorlosen Drehzahlüberwachung bei Drei- und Einphasen Motoren Safety switchgear unit to monitor the speed of 3-phases and single phase motors without sensor

EG-Richtlinien/EC-directives	Angewandte Normen/Applied standards
2006/42/EG EG-Maschinenrichtlinie/Machinery-Directive 2014/30/EU EMV-Richtlinie/EMC-Directive 2011/65/EU RoHS Richtlinie/RoHS-Directive	EN ISO 13849-1:2015 IEC 62061:2005 + AC:2010 + A1:2013 + A2:2015 IEC 61800-5-2:2016 IEC 61508: Parts 1-7:2010 IEC 60947-5-1:2016 EN 60204-1:2018 EN 61326-1 :2013 EN 61326-3-1:2017 GS-ET-20: 2016-10 (Zusatzanforderung)

Notifizierte Stelle/notified Body	EG Baumusterprüfbescheinigung/EC Type-Examination certificate
TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln Germany NB 0035	Reg.-Nr./No.: 01/205/5759.00/20

Dokumentationsbeauftragter/authorised representative.
DINA Elektronik GmbH Esslinger Str. 84 72649 Wolfschlugen Germany

Wolfschlugen, 01.06.2020

Stefan Najib (Geschaftsführer/CEO)

Content

Always read the additional applicable online documentation before working on/with the safety switchgear. Make sure you always work with the valid documentation. This is available online at *http://www.dina.de/downloads/*

Dispose of the device according to the national environmental regulations.

Symbol and Notes:

WARNING
This symbol indicates hazards that could lead to personal injury.

CAUTION
This symbol warns of actions that could lead to property damage or malfunction.

Here you will find additional information or further sources of information.

Version overview / Change history

Version	Date	valid for ID-No	Innovations / changes
0815	2020-06-10	34PD01	

1 Intended Use

DN3PD2 is a safety switchgear to monitor the speed of three-phase and single-phase motors without sensor.
It detects or monitors a minimum speed, a maximum speed or a speed range.
The unit meets Cat. 4/ PL e acc. to ISO 13849-1, SIL (CL) 3 acc. to IEC 62061 and IEC 61508.
It can be used in safety current circuit according to VDE 0113 T.1
The safety switchgear is configured using the configuration software GO:BEYOND.

1.1. Approvals

1.2. Safety parameters

The unit meets Cat. 4/ PL e and SIL (CL) 3.

Utilization categories	PFH_d [h]	$MTTF_d$ [a]	DC_{avg}
6A DC1 2 cycles/h	$5{,}38 \times 10^{-9}$	441	99%
4A DC13 2 cycles /h	$1{,}33 \times 10^{-8}$	198	99%
6A AC1 2 cycles /h	$1{,}87 \times 10^{-8}$	153	99%
5A AC15 2 cycles /h	$1{,}87 \times 10^{-8}$	153	99%

1.3. Ordering data

Description		Type	ID-No.:
Speed monitoring, sensorless	0-1200Hz, 2 contact outputs, USB interface	DN3PD2	34PD01

2 Safety regulations

- The device may only be installed and commissioned by an electrician or trained persons who are familiar with these operating instructions and the applicable regulations regarding work safety and accident prevention.
- Observe the VDE, EN and local regulations, particularly with respect to the protective measures.
- Failure to observe the regulations may result in death, severe bodily injury or extensive property damage.
- For emergency-stop applications, either the integrated function for restart interlock must be used or automatic restarting of the machine must be prevented by means of a higher-level control.
- During transport, storage and operation, adhere to the conditions specified in EN 60068-2-1, 2-2!
- Unauthorized modifications shall render any warranty null and void. Dangers may thereby arise that could result in severe injuries or even death.
- Install the device in a control cabinet with a protection class of at least IP54! Dust and moisture may otherwise result in impaired functions. Installation in a control cabinet is mandatory.
- Ensure adequate protection circuits at output contacts for capacitive and inductive loads!
- The device is to be installed taking into account the distances required per DIN EN 50274, VDE 0660-514.
- During operation, switching devices carry dangerous voltage. Do not remove protective covers.
- Replace the device after the first malfunction.
- Properly dispose of the device at the end of its service life.
- If these regulations are not adhered to or in the event of improper use, DINA Elektronik GmbH accepts absolutely no liability for the resulting property damages or personal injury.
- Save this product information!

3 Important information and validation

- The product described here was developed to perform safety-related functions as part of a complete system.
- The complete system consists of sensors, evaluation and message units as well as concepts for safe shutdowns.
- It is the responsibility of the manufacturer of a system or machine to ensure the proper overall function.
- The manufacturer of the system is required to test and to document the effectiveness of the implemented safety concept within the complete system.
  In this case, it must be checked whether the release contacts open when exceeding or falling below the thresholds.
- This verification is to be performed after every modification to the safety concept or to safety parameters.
- DINA Elektronik is not in the position to guarantee the properties of a complete system that was not designed by DINA.
- DINA Elektronik GmbH also accepts no liability for recommendations that are given or implied by the following description.
- No new guarantee, warranty or liability claims that extend beyond DINA's general delivery conditions can be derived on the basis of the following description.
- To avoid EMC disturbances, the physical environmental and operating conditions at the installation location of the product must comply with section EMC of DIN EN 60204-1.
- When using contact outputs, the safety function must be requested once a day at PL e and once a year at PL d according to IEC 61800-5-2.
- Observe the general technical data at the end of this operating manual.

4 Function description

The two-channel evaluation unit of the safety switchgear module measures the frequency of the effective rotating field of the motor at the measuring terminals L1, L2, L3.
If the parameterized switching threshold frequencies are exceeded or undershot (fmin and fmax), or an internal or external fault exists, the enabling current paths 13/14, 23/24 open immediately. The device is in safe switching state.
The device has a standard USB connection. The configuration software enables a parameterization and online monitoring. After applying the operating voltage (24 V DC) to terminals A1 and A2, the safety relay will operate a self-test. The safety relay is in safe condition for the duration of the self-test. All enable current paths are open. After a successful self-test, the device is ready for operation. The LED OK lights up green.

4.1. Speed monitoring

The parameters fmax (maximum frequency) and fmin (minimum frequency) define the speed limits of the motor.
The limit frequencies fmax and fmin are calculated from the speed n and the number of pole pairs:
f [Hz]= (n [U/min] / 60) x number of pole pairs
Example: 5000 rev /min x 3 (number of pole pairs) / 60 = 250Hz

Asynchronous motors have a load-dependent slip between the motor speed and the rotating field frequency. This must be observed by the configuration of the switching threshold (fmin and fmax).

CAUTION
Note that the method of frequency measurement does not recognize a mechanically blocked motor or an overloaded motor!

The following monitoring functions are possible:
- Monitoring only at maximum speed
- Monitoring of a speed range with startup monitoring
- Monitoring of a speed range without startup monitoring

fmin: minimum frequency
If fmin is undershot, the output contacts (13-14 / 23-24) switch off.
They switch on again after the acknowledgment via the acknowledgment input Q.
Depending on the acknowledgment mode, the switch-on-conditions differ. Please note the chapter "Startup monitoring". If fmin = 0 there is no monitoring to a minimum speed. The output contacts remain closed at standstill.

fmax: maximum frequency
If fmax is exceeded, the output contacts (13-14 / 23-24) switch off.
They switch on again after the acknowledgment via the acknowledgment input Q, if fmax (minus hysteresis) is undershot.

CAUTION
Note that a coasting motor is detected either as a standstill (if fmin = 0, no switch-off) or underrun (if fmin> 0, switch-off).

4.2. Acknowledge function

The acknowledgment function allows the module to be reset to operational readiness after a shutdown due to under- or overspeed. The reset takes place via the input Q at the module, if none of the mentioned states is present.
Automatic or manual acknowledgment is possible. With automatic acknowledgment, the Q input must always be connected to 24V DC.
A manual acknowledgment takes place after a falling signal edge at the input Q (tQ ≥ 200ms and ≤ 10s).

4.3. Start-up monitoring

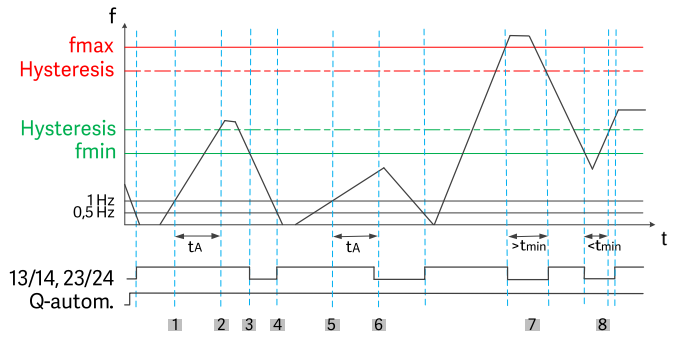
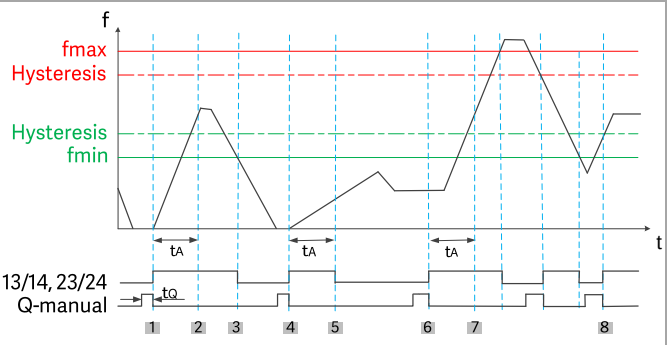
The startup monitoring time tA is a time limit within which the actual speed must be greater than fmin. If the minimum speed is not reached during this time, the enable current path opens again.
The start-up monitoring time is parameterized (0s to 60s). It is not retriggerable, it cannot be restarted while it is running.

The start-up monitoring time starts

- In case of manual acknowledgment: with the falling edge of the acknowledge signal
- In case of automatic acknowledgment: if the actual speed is> 1Hz

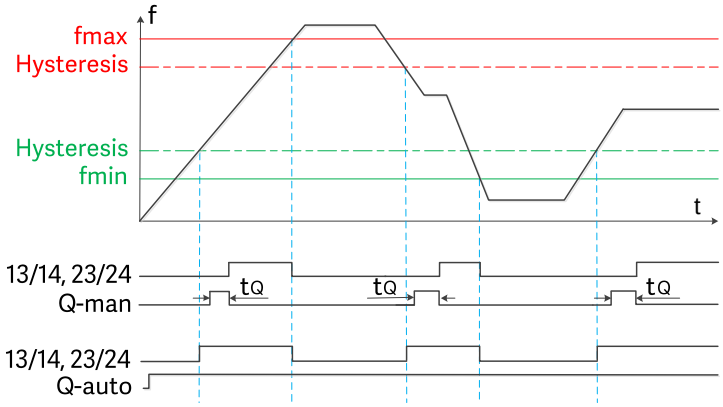
In the acknowledgment mode without startup monitoring (0s), the outputs only switch on within the permitted range.

4.3.1. Functional diagram with start-up monitoring

Automatic acknowledgement (fmin must be at least 1,1Hz !)	Manual acknowledgement
	

1	Start-up monitoring time starts if f>1Hz	1	Start-up monitoring time starts with the falling edge of the acknowledgement signal.
2	Start-up monitoring time is expired. Enabling current path remains closed because f>fmin.	2	Start-up monitoring time is expired. Enabling current path remains closed because f>fmin.
3	Enabling current path opens because f<fmin	3	Enabling current path opens because f<fmin.
4	Enabling current path closes, if f<0,5Hz.	4	Start-up monitoring time starts with the falling edge of the acknowledgement signal.
5	Start-up monitoring time starts if f>1Hz.	5	Start-up monitoring time is expired. Enabling current path opens because f < fmin1.
6	Start-up monitoring time is expired. Enabling current path opens because f < fmin.	6	Start-up monitoring time starts again.
7	The setpoint speed was reached outside of the minimum switch-off time. Enabling current path closes.	7	Start-up monitoring time is expired. Enabling current path remains closed.
8	The setpoint speed was reached within the minimum switch-off time. Enabling current path closes after 0.5s.	8	Enabling current path closes because fmin < f < fmax

4.3.2. Functional diagram without start-up monitoring



4.4. Switch-off delay

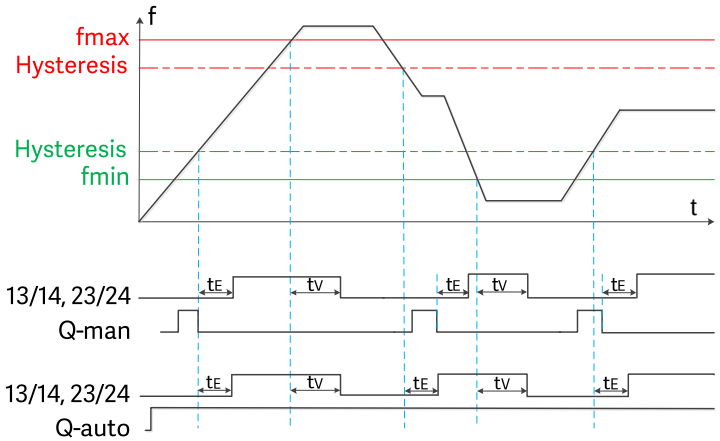
Optionally, you can set a switch-off delay tV from 0s to 2s for the enable current path. The switch-off delay time starts if a speed limit is reached. During this time, the enable contacts remain closed and the "SPEED" LED flashes. When the switch-off delay time is expired, the enable current path opens.
If the speed reaches the target range during the switch-off delay time, the contacts remain closed and the switch-off delay time is reset.

CAUTION
Note that changing the switch-off delay affects the reaction time of the safety function!

The switch-off delay time is not started when the shutdown occurs due to an internal or external fault.

4.5. Switch-on delay

Optionally, you can set a switch-on delay tE from 0s to 10s for the enable current path. The switch-on delay time starts, if the frequency is in range and the acknowledgement is done. During this time, the enable contacts remain open and the "SPEED" LED flashes.
When the switch-on delay time is expired, the enable current path closes.



tE = switch-on delay tV = switch-off delay

If you have also selected the "Start-up monitoring" function, the outputs only switch on after the switch-on delay time has expired. Only then is the start-up monitoring active.

4.6. Advanced settings

Application dependent disturbances (e.g., vibrations or frequency overshoots) can adversely affect the measurement process. This can lead to unintentional shutdowns. To ensure availability in the case of faulty applications, you can adjust the parameters

- Number of measuring cycles
- Measurement sensitivity

Number of measuring cycles
In the settings "measuring accuracy" you set the number of measuring cycles to detect the movement. The parameter determines with how many measurements the measured value is formed before it is switched off.
This multiple measurement has no influence on the switch-on behavior. Switching on takes place after one measuring cycle.
Default setting: 3 measuring cycles at frequencies > 30Hz
Maximum number of measuring cycles: 4

CAUTION
The set factor is multiplied by the measuring time of the system and influences the reaction time of the safety relay.

Few measuring cycles = short reaction time due to fast measuring value formation, but more prone to external disturbances
One measuring cycle = fastest reaction time
Many measuring cycles = long system reaction time but robust measurement

You can change the number of measuring cycles in the configuration software. You also define from which frequency this number should be valid.
Below this frequency, a single measurement is always used.

Sensitivity
Change these parameters only after consultation with the DINA Elektronik GmbH service.

4.7. Minimum switch-off time

The minimum switch-off time t_{min} is the time that the enable current path is at least open after triggering before it switches on again. It is 0.5s.

4.8. Password

The transfer of the parameters and the validation function can be password protected. The password can contain a maximum of 8 characters.

4.9. Validation

To validate the safety function, a validation tool is available in the configuration software.
With this function, the limit values fmax and fmin are reduced or increased by 10%, 20% or 30%, thereby forcing a switch-off.
The validation requires the entry of the device password.

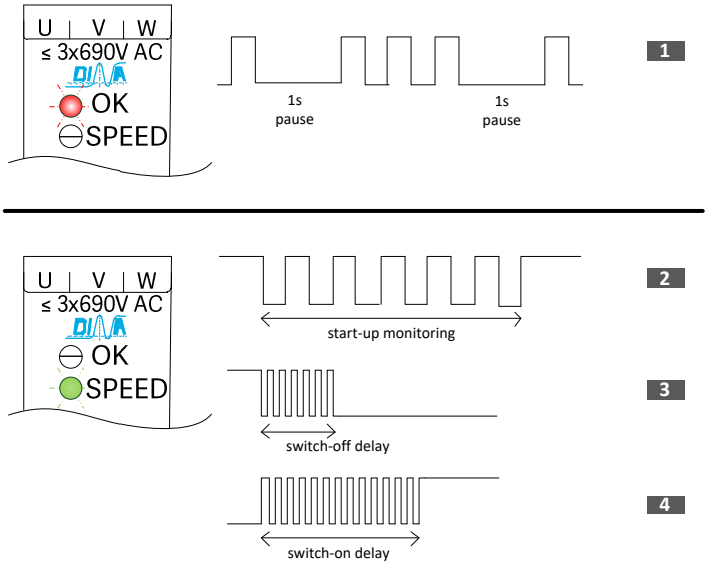
Note that validation displays the actual frequency, not the actual speed.
The relation actual frequency to speed (taking into account the number of poles and the gear factor) may have to be additionally validated.

4.10. Display

The safety switchgear indicates its operational readiness and the status of the enabling current path by the two-color LEDs "OK" and "SPEED". See table 4-1.
The red flashing LED "OK" indicates an error.
The green flashing LED "SPEED" indicates the expiry of a time constant.

LED OK	LED SPEED	Flash-code	13/14, 23/24	Status	
green	green	-	ON	acknowledged	in range
green	OFF	-	OFF	not acknowledged	out of range
green	flashing green	2	ON	acknowledged, start-up monitoring active	out of range
green	flashing green	3	ON	acknowledged, off delay active	out of range
green	flashing green	4	OFF	acknowledged, on delay active	in range
green	OFF	-	OFF	not acknowledged	in range
flashing red	OFF	1	OFF	error	See error table
red	red	-	OFF	device defect	

table 4-1



4.11. Diagnosis

In conjunction with the configuration software, diagnostics offers the following functions:

- Reading out values from the safety switchgear during operation
- Reading out data which are relevant for switch-off

4.12. Signal outputs

You can use the signal outputs O1 and O2 to control e.c. a non-safety PLC or signal units.
The message outputs have the following properties:
- digital
- potential-bound
- short circuit and overload protection
- not safety-related

The output O1 indicates the state of the enabling current path.
The output O2 indicates the operational readiness. This switches off in case of an error.

4.13. USB interface

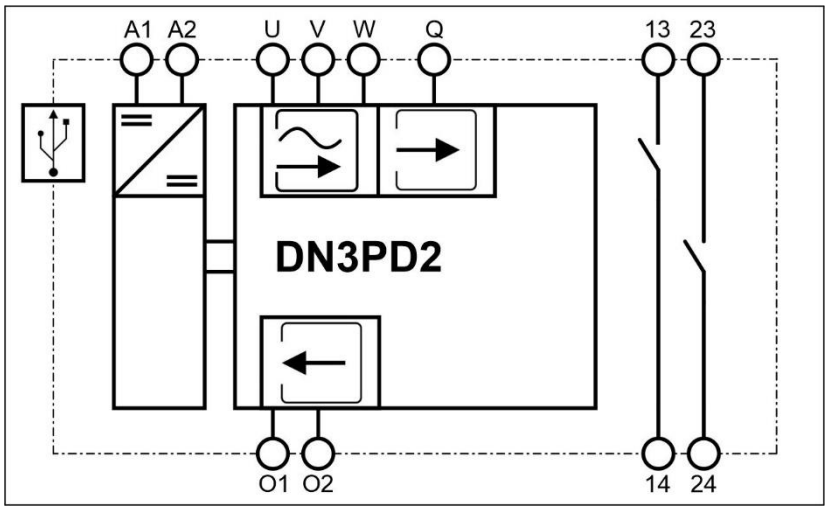
Via the USB connection you connect the safety s to the PC (standard USB 2.0). You need the PC connection for the following actions:

- Transfer the configuration data
- Read out the configuration to open it in the configuration software as a project and edit it if necessary.
- Diagnosis
- Validation

4.14. Connections

U, V, W	Measuring inputs are to be connected directly to the motor, without switching contacts between
A1	Power supply +24V DC
A2	Power supply 0V
Q	Acknowledgment input can be parameterized, manually or automatically
O1, O2	Digital positive switching semiconductor outputs for the transmission of switching states to a higher-level control for diagnostic tasks.
13-14/23-24	Enabling contacts (2 NO-contacts). These switch off immediately if the parameterized speeds are undershot or exceeded or internal or external errors. 13/14, 23/24 are to be used in such a way that the intended safety function, e.g. emergency stop is executed.
USB Port	Mini-USB for connection at PC
OK-LED	operational readiness
SPEED-LED	state of the enabling current path

4.15. Block diagram

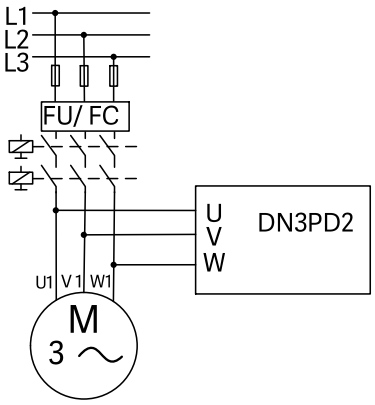


5 Applications

5.1. Motor with frequency converter

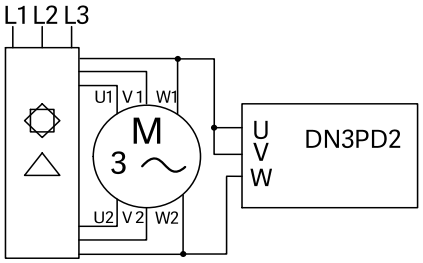
The operation on electric power drive systems with adjustable speed is possible. (Frequency converter)

CAUTION
Please note, that the DN3PD2 is not suitable for use on thyristor inverters.



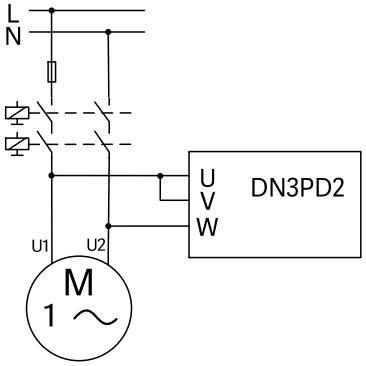
5.2. Motor with star-delta circuit

Operation on motors with star-delta connection or pole changeover is possible. For pole-changing motors, please note that DN3PD2 detects the frequency and not the speed!
The measuring inputs U and W are bridged and directly connected to W1 on the motor.
The measuring input V is directly connected to W2 on the motor.



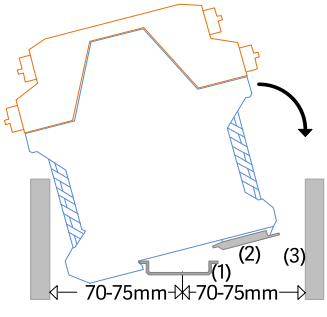
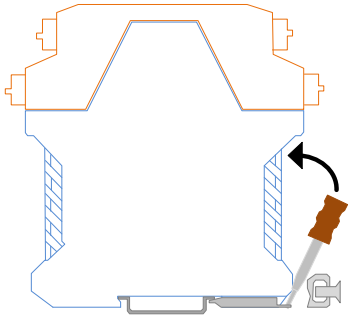
5.3. Single-phase motor

Operation on a single-phase motor is possible.
The measuring inputs U and W are bridged and directly connected to U1 on the motor.
The measuring input V is directly connected to U2 on the motor.



6 Mounting and removal

- Mount the safety relay on a 35 mm DIN rail according to EN 60715.
- Maintain the required distances according to DIN EN 50274, VDE 0660-514.
- Avoid strong magnetic fields near the installation. (Magnetic field strength <30 A / m). These can disturb the device.
- For removal, release the locking foot with the help of a screwdriver and lift the safety switch off the mounting rail.

Mounting		Removal
	(1) DIN rail (2) lock device (3) cable channel	

6.1. Wiring notes

- Use copper wires approved up to 60°C/75°C.
- For of wire end sleeve is recommended.
- Loads connected to the measuring wires are not allowed.
- The laying of the measuring wires must prevent a cross or short circuit. Installation in a cable channel is necessary.
- Observe the regulations according to EN 60204-1.
- To prevent contact welding, insert an effective suppressor parallel to the load.
- Observe the arrangement of overcurrent protection devices.
- Overvoltage > 32V DC destroy the device. Only use power supplies that generate a maximum of 32V in the event of a fault.

7 Configuration

The configuration of the DN3PD2 safety switchgear is made via the configuration software GO:BEYOND.
The parameterization of the DN3PD2 is described in the following chapters.

WARNING: Danger through incorrectly set parameters
Incorrectly set parameters for motion monitoring can lead to dangerous machine or system states.

- Make sure that the parameters entered or selected in the software correspond to the connected hardware.
- Carry out a function test after parameterization and after every change in the parameterization as part of the validation.

Assistance during validation and commissioning can be a separate measuring device or the diagnostic function (display of actual and limit values) in conjunction with the validation function in the configuration software.
The diagnostic function is **not** safety-related.

7.1. System requirements

The configuration software is compatible with the following operating systems

- MS Windows 8
- MS Windows 10

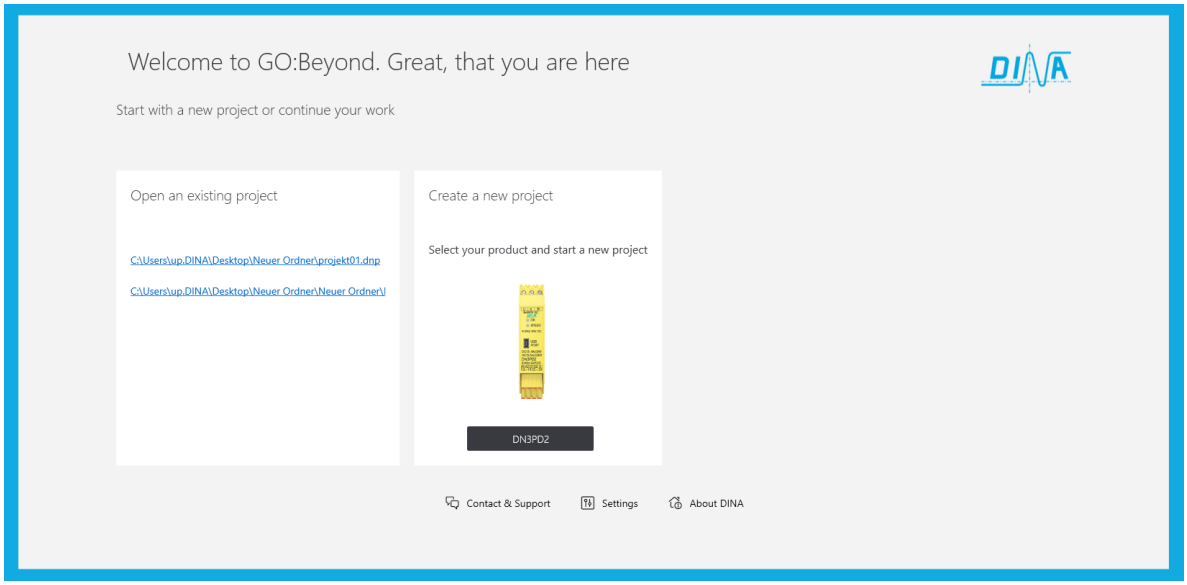
Hard disk space	min. 1 GB
Main memory	min. 2 GB
Resolution	1920 x 1080 px
Scaling	100%
Interface	USB

7.2. Installation the Configurations-Software

The configuration software can be found in the download area of the article at **dina.de/downloads/software**.
Always work with the latest version of the software.

Installation of the software:

1. Download the software.
2. Start the installation.
3. Follow the instructions of the installation wizard.
4. Choose the language about “Settings” in the start screen.

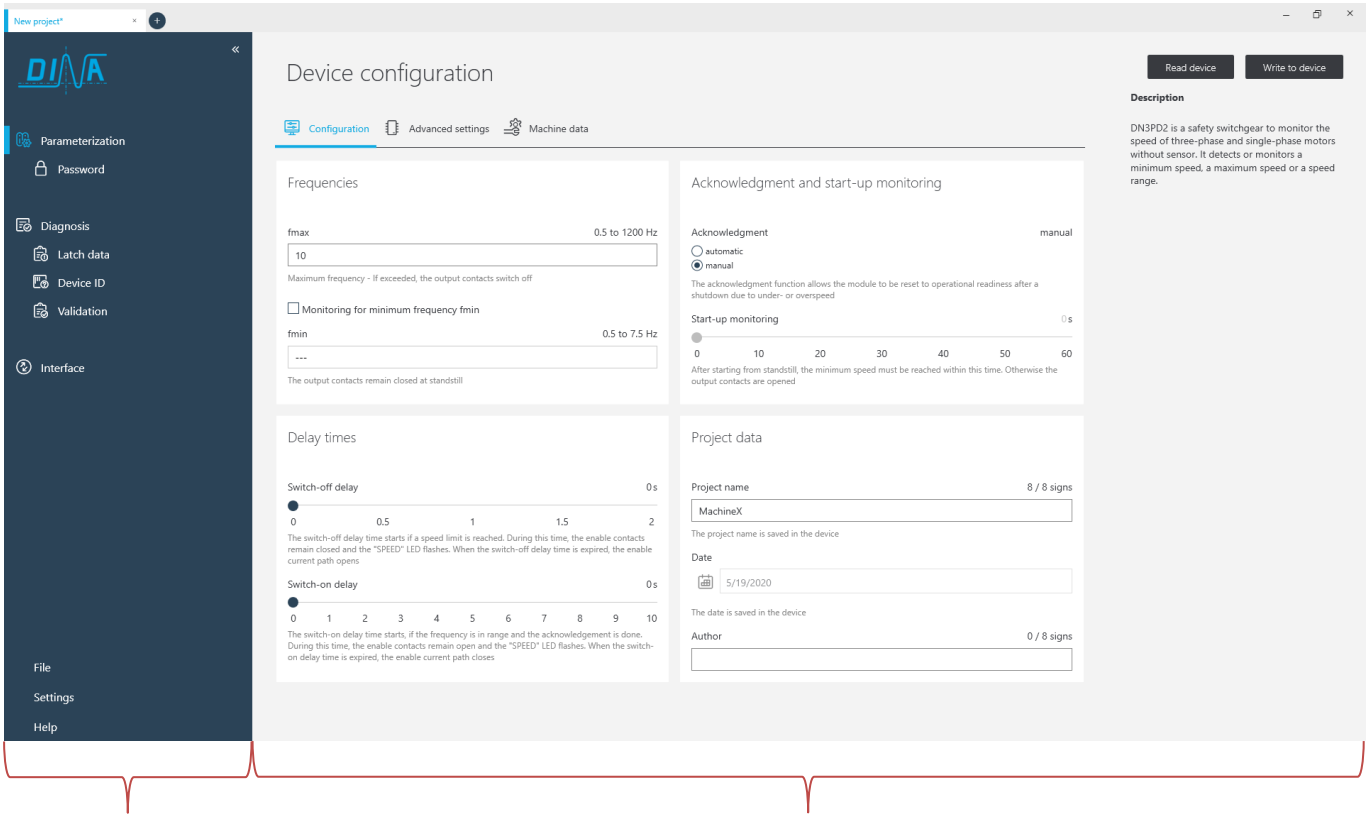


7.3. Connection to the PC

Communication between the safety switchgear and the configuration software takes place via the USB interface.
Connect the safety relay to the PC using a suitable connection cable.
The interface is suitable for standard USB cables.

7.4. User interface

The configuration software has the following user interface.



Navigationsbereich **Editor- und Aktionsbereich**

Navigation area
In the navigation area you can select the following areas:

- Parameterization — edit parameters, password management
- Diagnostics — display of online values, error messages, switch-off-relevant data, device ID, validation
- Interface — selection of the interface
- File — new creation / saving / opening / printing / closing a project
- Settings — display of the working directory
- Help — help-menu

Edit- and Action area
This area offers the following functions:

- Edit parameters
- Read out the parameter from the switch gear to the configuration-software
- Transmit the parameter from the configuration-software to the switch gear
- Help

7.5. Parameterization

You can make the following settings on the configuration software

Parameter	Range	Note
COM-Port		
Password	maximum 8 signs	
fmax *)	0.5 - 1200 Hz	
fmin *)	0.5 - 1200 Hz	Minimum speed monitoring can be deselected.
Acknowledgment	- manual - automatic	Automatic acknowledgment with start-up monitoring: fmin ≥ 1.1 Hz
Start-up monitoring	0-60s	0 ≙ only range-monitoring
Switch-off delay	0-2s	
Switch-on delay	0-10s	
Project name	maximum 8 signs	absolutely necessary
Author		Is not transferred to the device.
Date	mm.dd.yy	
Advanced settings		
Measurement accuracy		
Number of measuring cycles	1-4	
Frequency threshold	16 steps	
Measurement sensitivity	mode 1-4	
Machine data		
Axis type	Linear axis, spindle, rotary axis	
Number of pole pairs	1-99	
Ratio	0.01-99999	
Radius	1-9999	
Pitch	0.001-9999	
Max. speed		Depending on the machine data and the permitted maximum frequency.
Min. speed		

*)

- To determine the switching thresholds, the number of pole pairs must be taken into account:
  f [Hz]= (n [U/min] / 60) x number of pole pairs
  Example: 5000 rev/min x 3 (number of pole pairs) / 60 = 250Hz
- Asynchronous motors have a load-dependent slip between the motor speed and the rotating field frequency. This must be taken into account when parameterizing the threshold frequencies (fmin and fmax).

7.6. Machine data

The "Machine data" calculation tool can be used to determine fmin and fmax.
Enter the machine-specific data and the tool calculates the associated frequencies. The machine data can be saved in the device. Check the checkbox "Take over machine data". Then it is no longer possible to enter the frequencies directly in the "Parameterization" menu.

7.7. Read out the project

You can read out the parameterization saved on the safety relay.
No password is required for reading out.

- Start the configuration software"
- Open the "Interface" menu item and select the COM port.
- Open the "Parameterization" menu item.
- Click the "Read out device" button.

7.8. Create a project

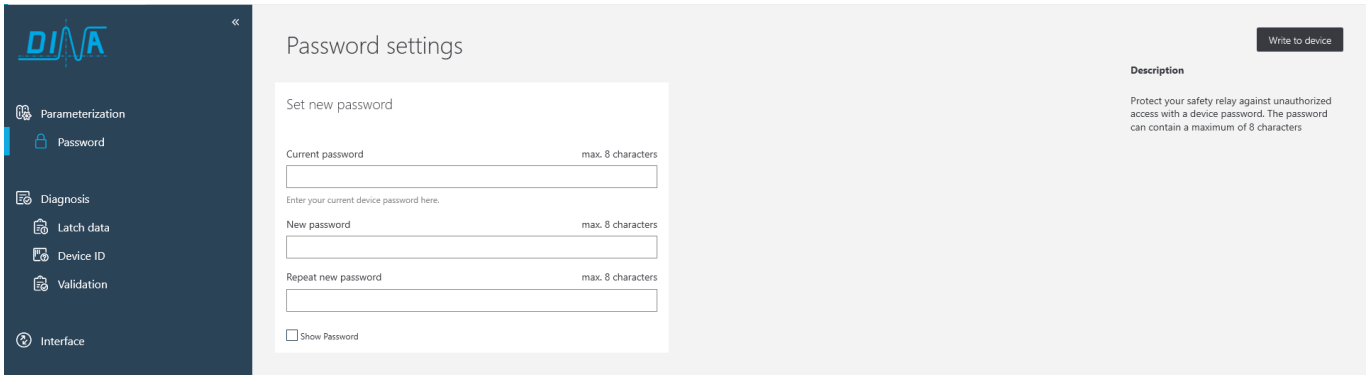
- Start the configuration software.
- Open the "Interface" menu item and select the COM port.
- Open the "Parameterization" menu item.
- Edit the parameter.
- Transmit the project to the device with the button „save on device“.
- There is always a password prompt. If no password is saved, confirm the query with "ok".
- Confirm the settings
- Save the project

7.9. Edit and Change password

Protect your safety relay against unauthorized access with a device password.

- Open the menu item "Parameterization password"
- Enter the current password. If no password is assigned, the field can remain empty.
- Edit a new password and confirm it.
- Click the button “save on device”.

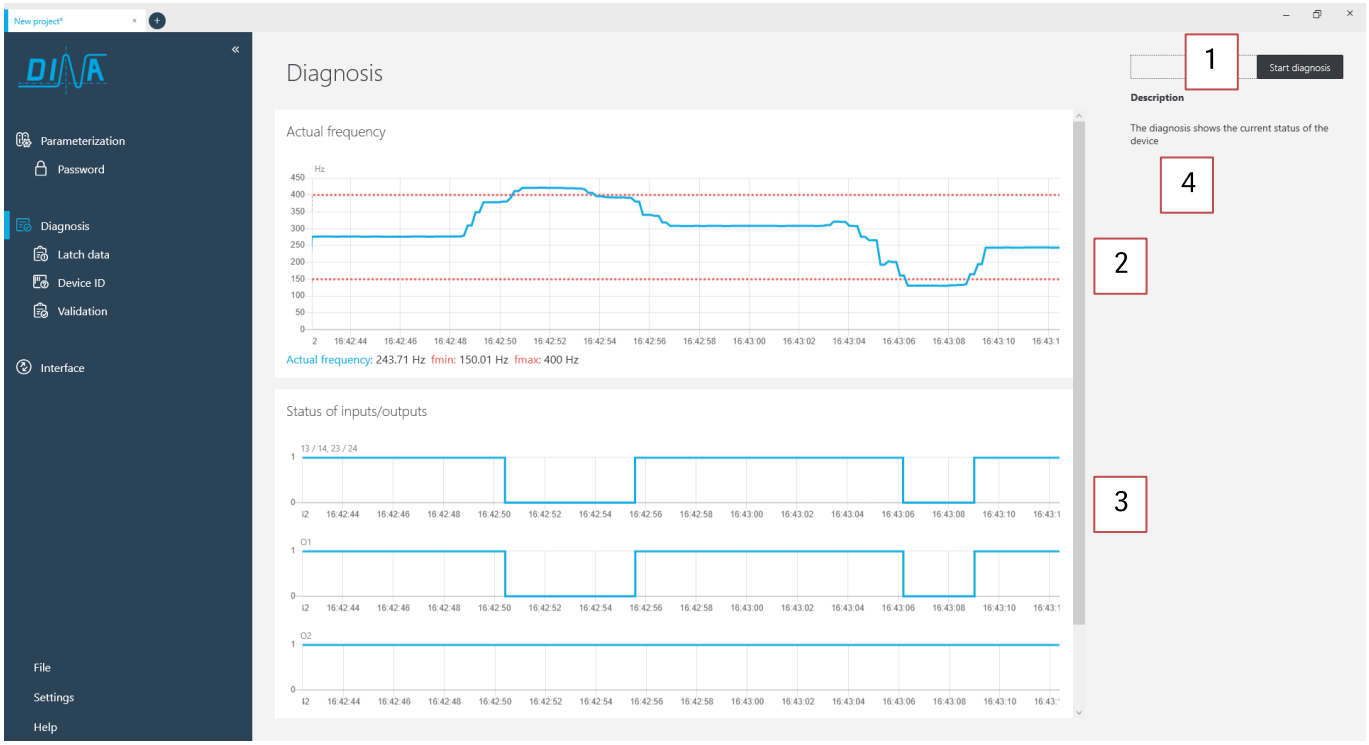
The password is now stored in the device and must be specified when transferring a new project or when validation.

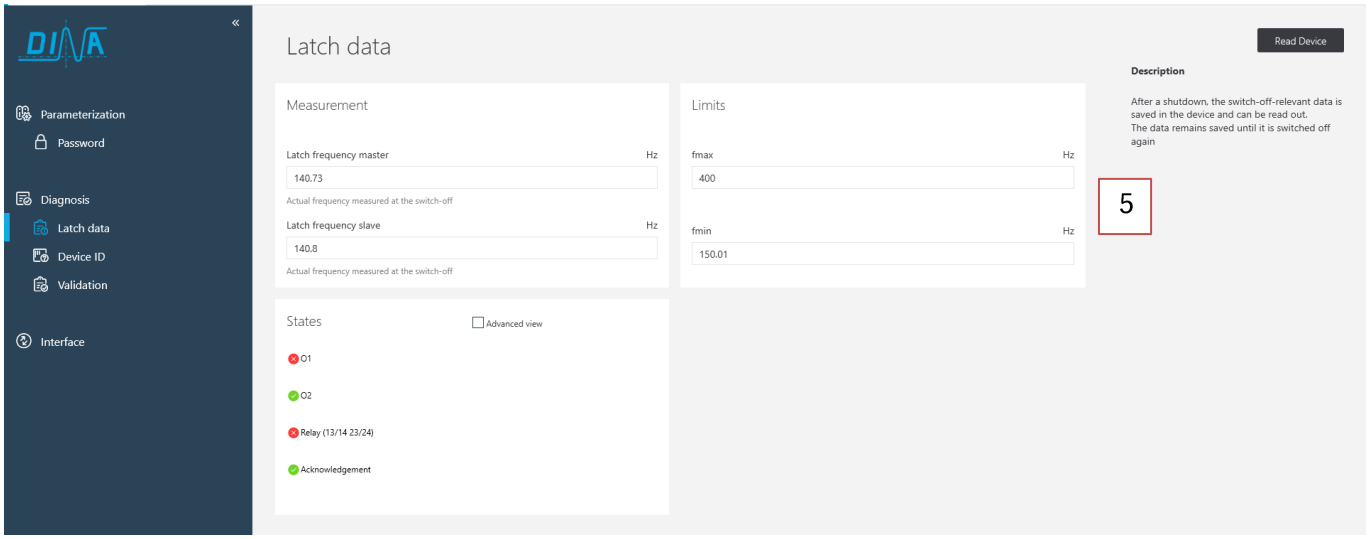


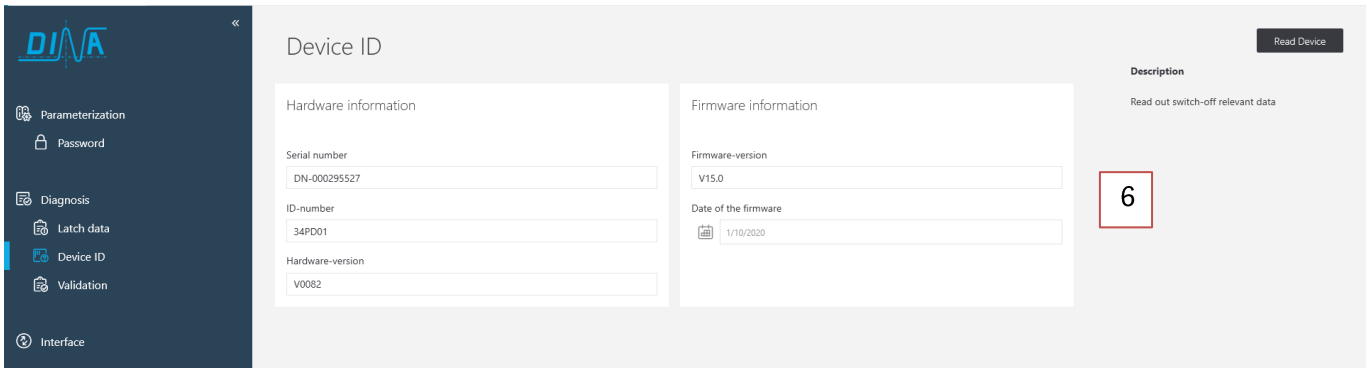
7.10. Diagnosis

The diagnosis offers the following functions:

1	**Diagnosis start / stop**	Start or stop the diagnosis
2	**Movement/time diagram**	For visual representation of the movement: blue line: actual frequency red lines: fmin and fmax
3	**Status display of the input and output**	13/14, 23/24: Status of the enabling current path O1: Status the output O1 O2: Status the output O2 Q: Status of the input Q
4	**Help and error list**	Help texts and occurred errors
5	**Latch Data**	Read out switch-off relevant data - Actual frequency - States of the outputs/input - advanced mode for service
6	**Device ID**	Hardware and Firmware information
7	**Validation**	See chapter „Validation“




Parameterization
Password
Diagnosis
Latch data
Device ID
Validation
Interface
Latch data
Read Device
Measurement
Latch frequency master
Hz
140.73
Actual frequency measured at the switch-off
Latch frequency slave
Hz
140.8
Actual frequency measured at the switch-off
Limits
fmax
Hz
400
fmin
Hz
150.01
Description
After a shutdown, the switch-off-relevant data is saved in the device and can be read out.
The data remains saved until it is switched off again
5
States
Advanced view
O1
O2
Relay (13/14 23/24)
Acknowledgement

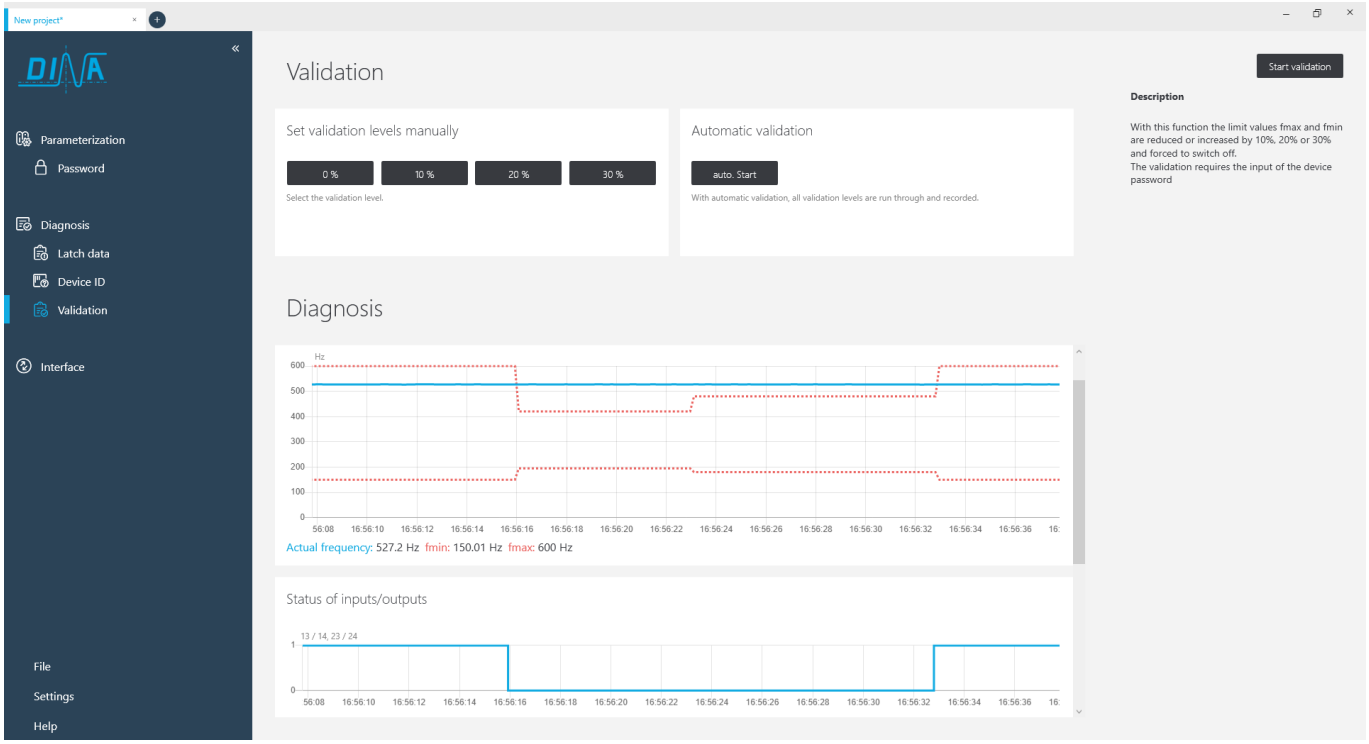

Parameterization
Password
Diagnosis
Latch data
Device ID
Validation
Interface
Device ID
Read Device
Hardware information
Serial number
DN-000295527
ID-number
34PD01
Hardware-version
V0082
Firmware information
Firmware-version
V15.0
Date of the firmware
1/10/2020
Description
Read out switch-off relevant data
6

7.11. Validation

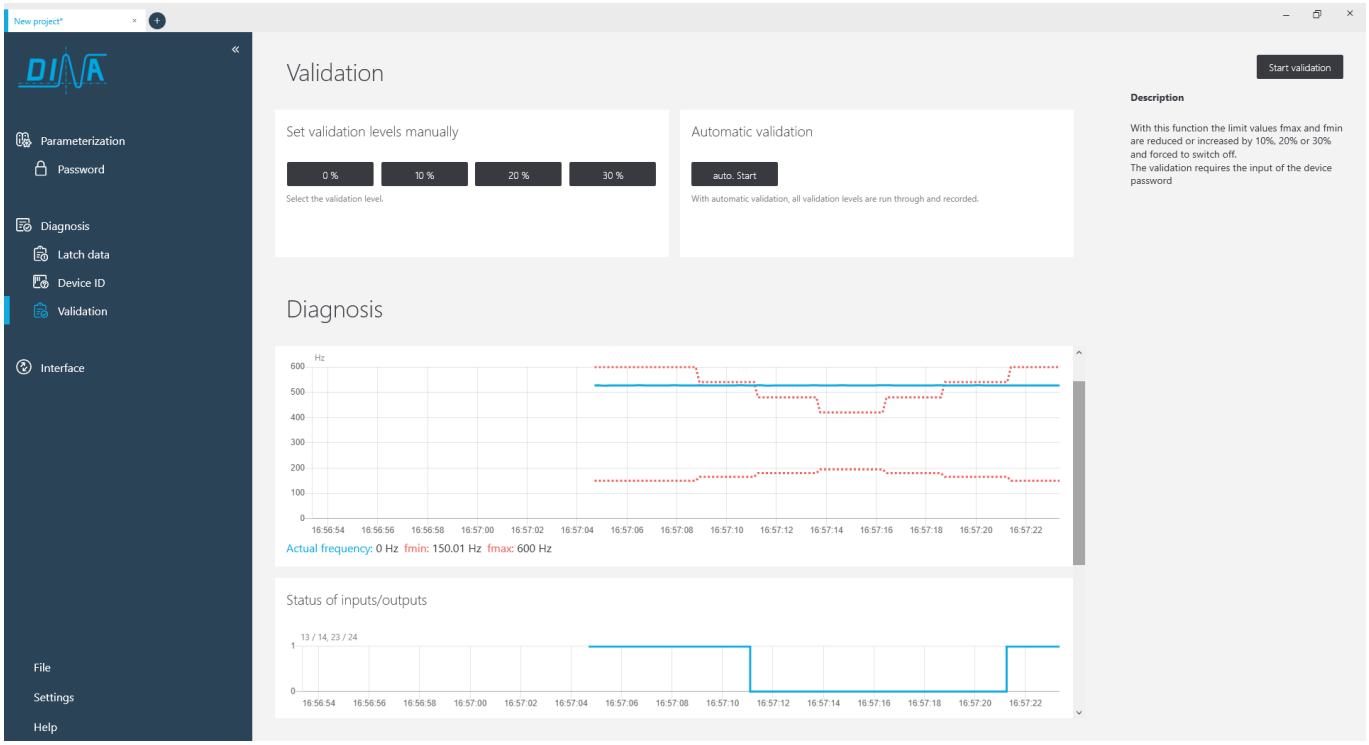
- ➢ Select the validation step
- ➢ If the device is password-protected, you will be asked to enter a valid password.

The states are recorded and can be printed out as a protocol.
The validation level is automatically reset after 10s.

- ➢ Press the “Stop Validation” button to stop recording



Alternatively, you can use the “auto. Start ”. The validation levels are run through step by step and reset again. The automatic validation stops automatically.



8 Errors: reporting and rectification

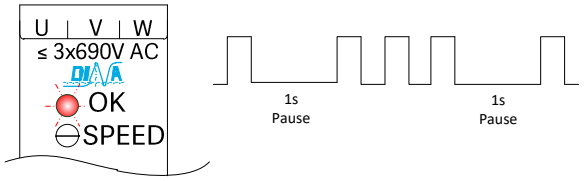
The safety switchgear shows diagnosed errors that lead to the safe state of the device, as follows:

- Flash-codes of the LED „OK“ on the device.
- Error message in the software

8.1. LED-flash-codes

The safety relay displays error messages using LED flashing codes.
The blink code is repeated continuously with a pause of 1 s.
The meaning of the individual LED blink codes can be found in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Example:
3 x flash / 1 s break / 3 x flash / 1 s break ...
That means **error no. 3.**

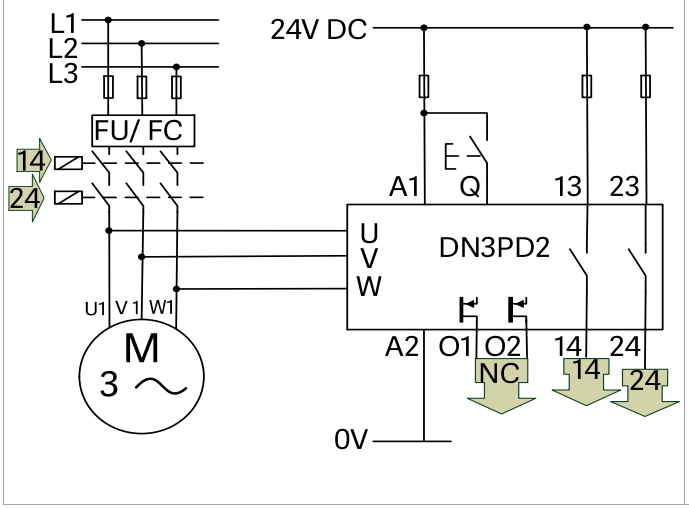


Error-no.	LED-flash-code	Meaning / diagnostic information from the software	Remedy
1	1 x flash	incorrect power supply	Check power supply UB = 20.5V-26,5V DC
2	2 x flash	transmission error parameter	Check • interface • connection cable • Have the parameters been confirmed before transfer?
3	3 x flash	incorrect acknowledge signal at input Q	Check the wiring at input Q for cross or short circuits. **For manual acknowledgment:** Check whether the start signal is within the time range of min. 200ms to max. 10s.
4	4 x flash	open-circuit on U, V, W	Check the wiring at the measuring inputs for • short circuit • cross-connection • wire break
5	5 x flash	transmission error password	The password was not confirmed. Transfer the password again.
6	6 x flash	Relay error	Send the device to DINA Elektronik for testing.
7	7 x flash	single-channel error The signals at the measuring inputs are different	Check the wiring at the measuring inputs for • short circuit • cross-connection • wire break
8	8 x flash	Frequency > 1500Hz	Check the frequency at the measuring inputs
9	9 x flash	internal error	Send the device to DINA Elektronik for testing.
10	10 x flash	internal error	Send the device to DINA Elektronik for testing.

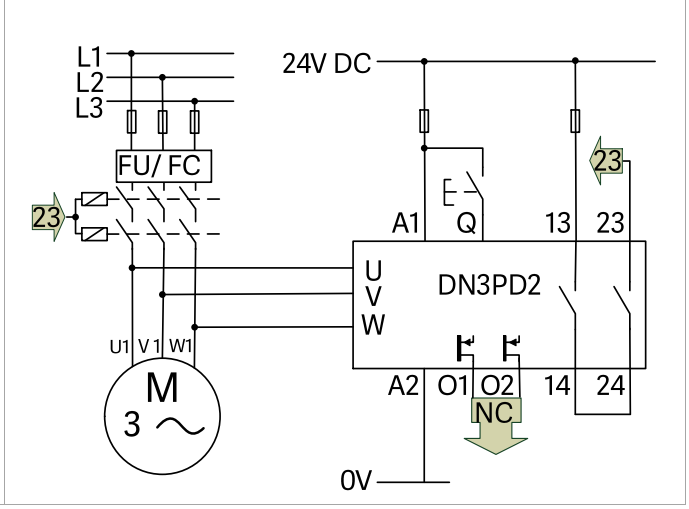
Table 8-1

9 Example of application

Output contacts connected in parallel



Output contacts connected in series



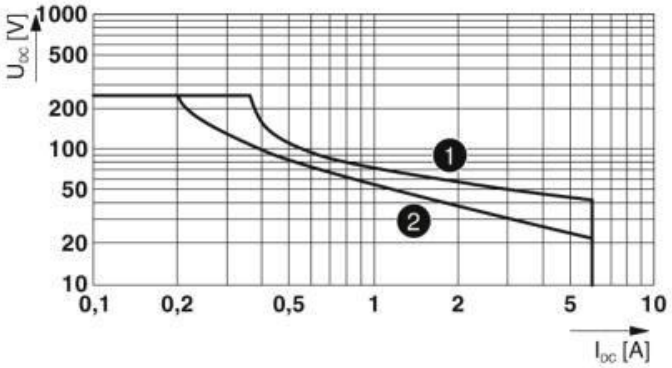
10 Technical data

10.1. Ambient conditions		
Ambient temperature (operation)	-20 to +55°C	
Ambient temperature (storage)	-40 to +85°C	
Maximum altitude	< 2000m above sea level	
Shock	15g	
Vibration	10–150Hz, 1g	
10.2. Input data		
Operating voltage UB	24V DC -15 % / +10 %, reverse protection	
Current draw at 24V DC	typ. 80mA	
Current draw at U, V, W	0,35mA at 690V AC	
Input voltage at U, V, W	90 to 690V AC	
Max. frequency at U, V, W	1200Hz	
Minimum-PWM	2kHz	
Measurement uncertainty	1%	
Switching hysteresis	10%	
Power consumption at A1/ A2	typ. 1,9W	
Status display	2 x LED 2-color	
Protection wiring	Overvoltage/ inverse polarity protection	
Acknowledgment input Q	24V digital	
10.3. Output data		
Relay outputs: enabling current path		
Contact type	2 enabling NO-contacts	
Contact material	$AgSnO_2$	
Operating voltage	24V DC / 230V AC	
Minimum switching current	3 mA/ 24V DC	
Maximum switching current	6A / 24V DC/ 230V AC	
Short-circuit strength	1000A SCPD 6A gL/gG	
Mechanical life	10^7 switching cycles	
Switch-off time	Number of measuring cycles x (period (*reciprocal value of the set frequency*) + max. 2ms cycle time) + max 10ms relay switch-on time	
Output fuse	6 A gL/gG	
B10d values acc. to DIN EN 61810-2-1, 01.2012	AC15: 5A/230V AC, >$2x10^5$, AC1: 6A/230V AC, >$2x10^5$	DC13: 4A/24V DC, >$3x10^5$ DC1: 6A/ 24V DC, >$7x10^6$ switching cycles
Total current 13-14 and 23-24	with parallel connection: 6A	with serial connection: 3A
Signal outputs		
Number of outputs	2 (non-safety, digital outputs O1, O2)	
Current	≤ 100mA, shot-circuit and overload protection	
Voltage	UB-1V	
10.4. General data		
Nominal operating mode	100 %	
Degree of protection	IP20	
Degree of protection of inst. location	closed cabinet, minimum IP54	
Mounting position	vertical or horizontal	
Air and creepage distances	DIN EN 50178	
Rated insulation voltage	400V AC	
Rated surge voltage / insulation	Basic insulation 6kV: between all current paths and housing Safe insulation, reinforced insulation 8kV: between U, V, W and USB interface between U, V, W and A1, A2, O1, O2, Q between U, V, W and 13/14, 23/24	
Degree of pollution	2	
Overvoltage category	III	
Housing material/ Type	Polyamide PA not increased/ ME/ Fa. Phoenix Contact	

Dimensions	B x H x T/ 22,5 x 114 x 111 mm		
10.5. Connection data			
Terminals/ Material	Push-in, pluggable/ PA		Screw, pluggable /PA
Number of positions	4	5	3
Conductor cross-section, flexible with wire end sleeve	0,25 - 2,5mm²	0,25 - 1,5mm²	0,25 - 2,5mm²
Conductor cross section AWG	24...12	24...16	24...12
Connection wire	60/75°C copper		
Tightening torque min/max			0,5Nm/0,6Nm

10.6. Relay load curve

Ohmic and inductive load for the enabling NO-contacts 13/14 und 23/24

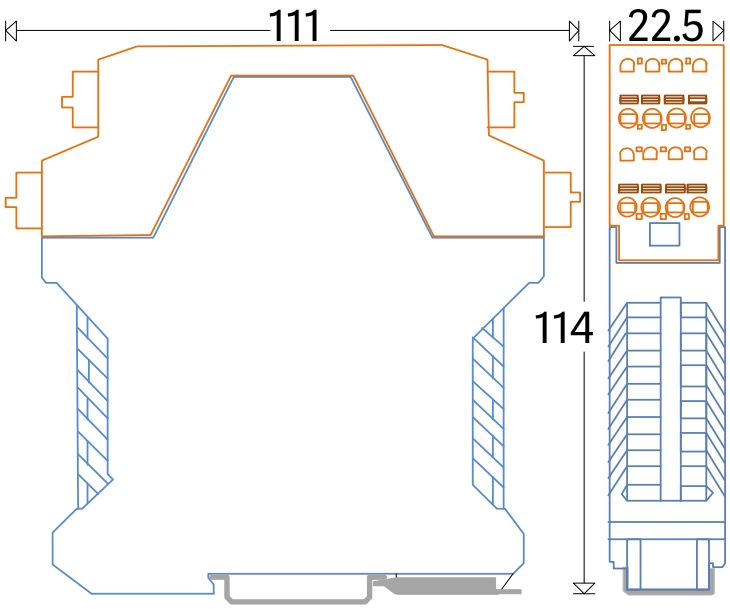


1 ohmic load L/R = 0ms

2 inductive load L/R = 40ms

WARNING
Loads with high capacitive component can destroy the output contacts because the switching current is very high.

11 Dimensions



wir sind sicherheit.

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