ADAMCZEWSKI
Elektronische Messtechnik GmbH
Felix-Wankel-Strasse 13
74374 Zaberfeld

Phone +49 7046 875
Fax +49 7046 7678
Email info@ad-messtechnik.de
Internet www.adamczewski.com

Operating Instructions

Multifunction Power Measuring Converter programmable

Version: 2.0.1

AD-LU 610 GA

AD-LU 610 GVF

AD-LU 310 GVC

Table of contents

Function and applications

The digital multifunctional measuring converter of series AD-LU 610 GA and AD-LU 610 GVF are freely programmable digital power measuring converter with two analogue outputs and one relay output. Individual phases or all phases of the three-phase mains can be connected at the input. All magnitudes of the three-phase current mains, i.e. effective power, reactive power, apparent power, voltages, currents, frequency and power factor are acqired measuring-technically and can be allocated to one or both analogue outputs.
The relay output can, for instance, be configured as energy meter or as limiting value indicator.
The digital multifunction measuring converter AD-LU 310 GVC is designed for one phase and has no relay output. Therefore, 2-conductor and 4-conductor can be connected with even load at the input and can be measuring-technically acquired.
The measuring ranges are programmable in wide ranges. Individually programmable filter functions supplement the adaptation possibilities to the measuring task. The measuring converter is programmed via a PC or laptop. The relevant configuring software „AD-Studio" and the programming cable are available as option.
Customer-specific settings ex works are, of course, possible on request.
The inputs are galvanically separated from the auxiliary voltage and the outputs.
The auxiliary voltage is designed as a.c. – d.c. supply.

Features

- Measuring of effective power.
- Measuring of reactive power.
- Measuring of apparent power.
- Measuring of currents.
- Measuring of voltages.
- Measuring of frequency.
- Measuring of power factors.
- Allocation of any measuring magnitude to the current output.
- Allocation of any measuring magnitude to the voltage output.
- Alternative function allocation of the relay output with energy impulses (S0), limiting values, or indication of the energy flow direction.
- Measuring of a single phase (L1) or of all phases (L1, L2, L3).
- Connection method with or without neutral conductor in 3- or 4-conductor method.
- Direct connection up to 630V (delta voltage) and up to 5A current, otherwise via external current and voltage transformers.
- Configuration of the measuring task and the external current and voltage transformer via the configuring software „AD-Studio".
- A.c. – d.c. supply.

Type key

Device type	Features
AD-LU 310 GVC	● Input one-phase main ● Current output 0..20mA ● Voltage output 0..10V ● Wide range supply ● PC-programmable
AD-LU 610 GVF	● See AD-LU 310 GVC ● Input one-phase and three-phase mains up to 500V/√3 ● Relay output
AD-LU 610 GA	● See AD-LU 610 GVF ● Input one-phase or three-phase mains up to 630V/√3

Technical data

Current inputs (AC 50/60Hz)

Rated range	0..5	A
Smallest measuring span	0.2	A
Max. power intake	0.3	VA/input
Permanent load 1)	10	A
Shock load 1)	100	A, 1s
Frequency range	40..50..400	Hz

1) According to DIN EN 60688.

Voltage inputs (AC 50/60Hz)

Rated range Un	50..360V 2)	V (star voltage)
Smallest measuring span	50	V (star voltage)
Max. power intake	0.5	mA/input
Permanent load 1)	1.2 * Un	V (star voltage)
Shock load 1)	2 * Un	V (star voltage), 1s
Frequency range	40..50..400	Hz

1) According to DIN EN 60688.

2) AD-LU 310 GVC and AD-LU 610GVF 50..288V

Current output 0..20mA

Output range	0..20	mA
max. burden	500	Ohm
Current limitation	Approx. 24	mA
Idle voltage	Approx. 12	V
Resolution	10	Bit

Voltage output 0..10V

Output range	0..10	V
min. burden	5	kOhm
Current limitation	Approx. 20	mA
Idle voltage	approx. 12	V
Resolution	10	Bit

Relay output

Max. switching voltage AC Max. switching current AC	250 2	V AC A AC
Max. switching voltage DC Max. switching current DC	50 2	V DC A DC

AD-LU 310 GVC without relay output

Error and influence effects

Linearity error P, Q, S	< 0.5	% v. E. under reference conditions. 1)
Temperature influence	< 0.3	% v. E. 0..50°C
Frequency influence	< 0.2	% v. E. 40..60Hz
Influence of the phase angle	< 0.2	% v. E. cos(phi) 0..1..0

1) according to DIN EN 60688.

Transmission behaviour

Measuring rate outputs, power factor	2	s/measuring
Measuring rate currents, voltages, frequency	1	mains periode

Supply

Supply voltage	50..253 20..253	V AC V DC
Max. power intake at 24V DC	2.4	W
Max. power intake at 230V AC	4.6	VA

Housing GA

Dimensions WxHxD	100x73x119	mm
Material		
Build-up	Hat rail 35mm, EN 50022	
Type of protection	IP20	
Connection method	Screw terminals	
Terminal cross-section	Max. 2.5	mm²
Weight	Approx. 200	g

Housing GFV

Dimensions WxHxD	33x110x128	mm
Material		
Build-up	Hat rail 35mm, EN 50022	
Type of protection	IP20	
Connection method	Screw terminals, can be pulled off	
Terminal cross-section	Max. 2.5	mm²
Weight	Approx. 150	g

Housing GFC

Dimensions WxHxD	18x110x128	mm
Material		
Build-up	Hat rail 35mm, EN 50022	
Type of protection	IP20	
Connection method	Screw terminals, can be pulled off	
Terminal cross-section	Max. 2.5	mm²
Weight	Approx. 110	g

Environmental conditions

Admissible ambient temparature	0..50	°C
Storage and transport	-10..70	°C

EMC

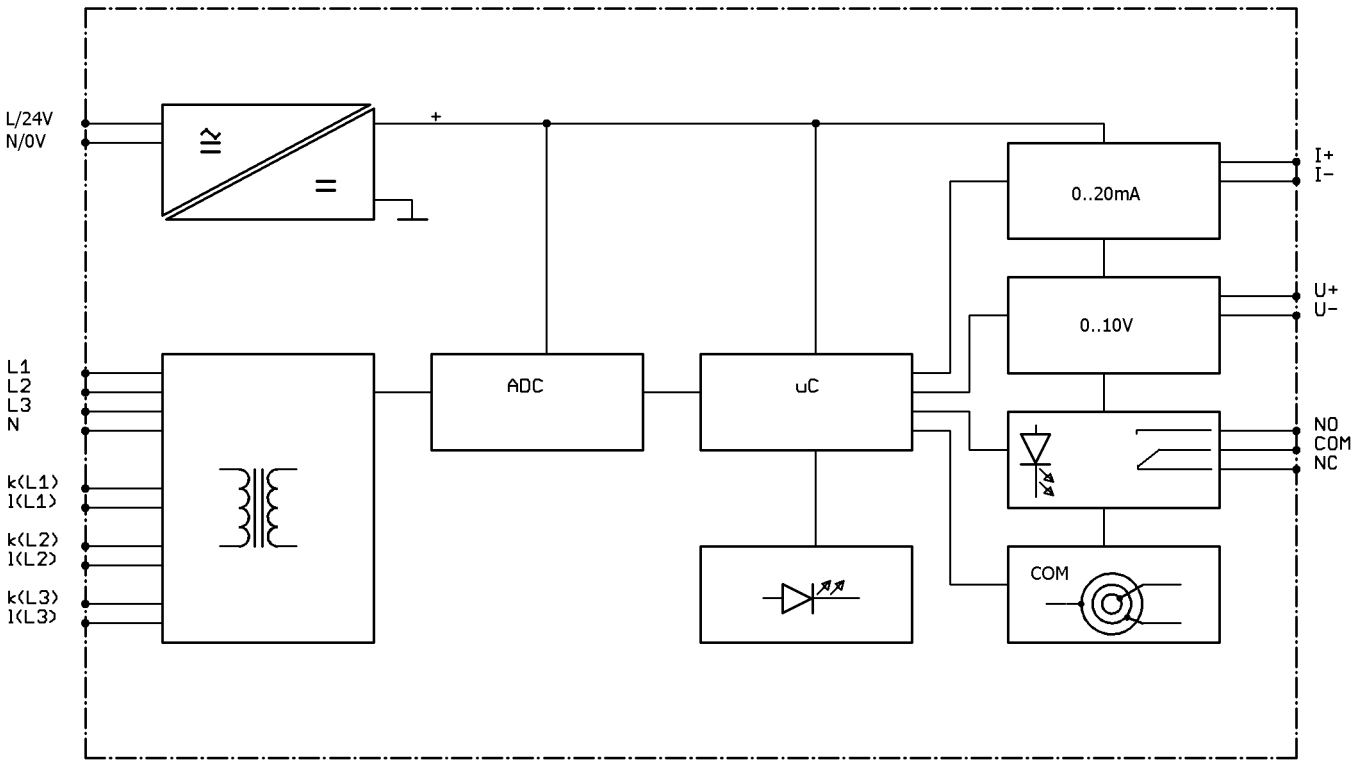
Produkt standard	DIN EN 60688
Discharge of static electricity, ESD	IEC 61000-4-2
Electro-magnetic fields 1)	IEC 61000-4-3
Rapid transients, burst	IEC 61000-4-4
Shock voltages, surge	IEC 61000-4-5
Line-routed HF-signals	IEC 61000-4-6
Error emmission	EN55011, CISPR11 class B, living area

1) Slight signal deviations are possible during the test.

Galvanic separation, test voltages

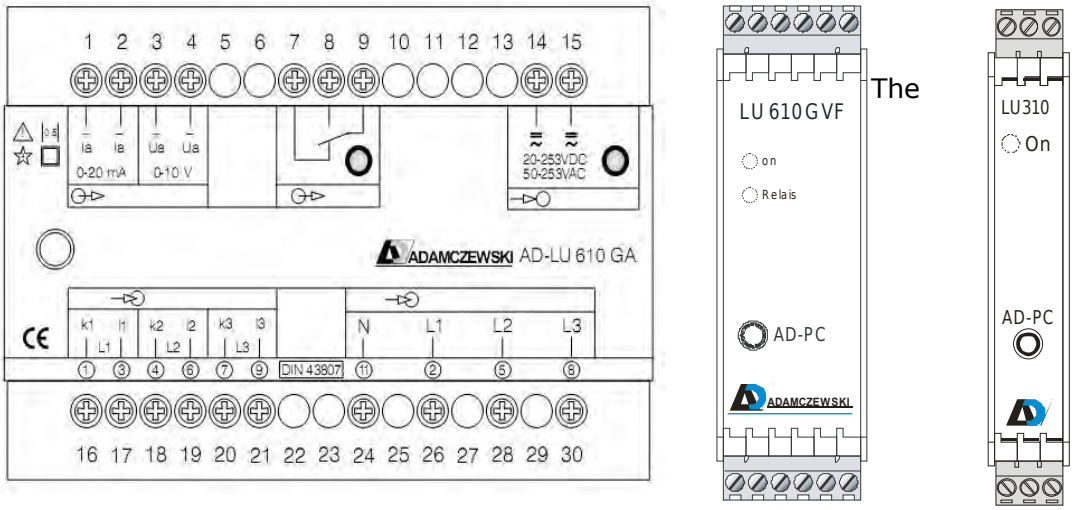
Input to outputs, input to auxiliary voltage	5	kV, 1min
Outputs to auxiliaray voltage	4	kV, 1min
Outputs amongst each other	none	
Output to programming interface	none	

Block diagram



Operating the device

Indication and operating elements



following indication and operating elements are at the front of the devices:

- A green LED for indication of the auxiliary voltage and the singal status.
- A red illuminated diode for indication of the relay status.
- A jack bush as configuration interface to a PC.

The operating modes

The device is always in one of the operating modes, which are explained in more detail below.

- Normal operation
- Signal error

Operating mode normal operation

After switch-on, the device is in normal operation and carries out all functions according to its set parameter as long as no error is present.

Operating mode signal error

A signal error is detected through monitoring the mains frequency of the first phase L1. If the frequency of L1 is outside the specified range, the device changes to operating mode signal error:

- The analogue outputs are set to the starting value of the emitting range.
- The relay releases.

Device parameter

The device parameter, which can be altered via the configurating programme „AD-Studio", are described below.

Inputs

Name	Works	Range	Unit	Comment
Primary current Ip	5	1..65535	A AC	Primary current of the external current transformer. Without: Ip = Is
Secondary current Is	5	1..65535	A AC	Secondary current of the external current transformer. Without: Ip = Is

Name	Works	Range	Unit	Comment
Primary voltage Up	230	50..65535	V AC	Primary voltage of the external voltage transformer. Without : Up = Us
Secondary voltage Us	230	50..65535	V AC	Secondary voltage of the external voltage transformer. without : Up = Us
Connection method	„4 phases, 4 conductor, uneven load"	„1 phase" „3 phase, 3 conductor, even load" „3 phases, 3 conductor, uneven load" „4 phases, 4 conductor, even load" „4 phases, 4 conductor, uneven load"		Determines the number of phases and the connection method. With „1 phase", L1 must be connected as phase, as the mains frequency is recorded via L1.
Measuring range effective power P1 in L1 1)	0..1.15	-1E6..1E6	kW	Measuring range of effective power in phase L1
Measuring range effective power P2 in L2 1)	0..1.15	-1E6..1E6	kW	Measuring range of effective power in phase L2
Measuring range effective power P3 in L3 1)	0..1.15	-1E6..1E6	kW	Measuring range of effective power in phase L3
Measuring range reactive power Q1 in L1 1)	0..1.15	-1E6..1E6	kVAr	Measuring range of reactive power in phase L1
Measuring range reactive power Q2 in L2 1)	0..1.15	-1E6..1E6	kVAr	Measuring range of reactive power in phase L2
Measuring range reactive power Q3 in L3 1)	0..1.15	-1E6..1E6	kVAr	Measuring range of reactive power in phase L3
Measuring range apparent power S1 in L1 1)	0..1.15	-1E6..1E6	kVA	Measuring range of apparent power in phase L1
Measuring range apparent power S2 in L2 1)	0..1.15	-1E6..1E6	kVA	Measuring range of apparent power in phase L2
Measuring range apparent power S3 in L3 1)	0..1.15	-1E6..1E6	kVA	Measuring range of apparent power in phase Phase L3
Measuring range current I1 in L1 1)	0..5	0..99999	A	Measuring range of current in phase L1
Measuring range current I2 in L2 1)	0..5	0..99999	A	Measuring range of current in phase L2
Measuring range current I3 in L3 1)	0..5	0..99999	A	Measuring range of current in phase L3
Measuring range voltage U1 in L1 1)	0..250	0..99999	V	Measuring range of voltage in phase L1
Measuring range voltage U2 in L2 1)	0..250	0..99999	V	Measuring range of voltage in phase L2
Measuring range voltage U3 in L3 1)	0..250	0..99999	V	Measuring range of voltage in phase L3
Measuring range frequency f in L1 1)	40..60	40..400	Hz	Measuring range of frequency in phase L1

Name	Works	Range	Unit	Comment
Measuring range total effective power P in L1...L3 1)	0...3.45	-1E6..1E6	kW	Measuring range of total effective power in the phases L1...L3
Measuring range total reactive power Q in L1...L3 1)	0...3.45	-1E6..1E6	kVAr	Measuring range total reactive power in the phases L1...L3
Measuring range total apparent power S in L1...L3 1)	0...3,45	-1E6..1E6	kVA	Measuring ramge of total apparent power in the phases L1...L3
Measuring range of power factor PF in L1...L3 1)	0...1	0..99999		Measurng range of power factors PF in phases L1...L3. PF = P/S.
Filter effective power L1	2	0..65535	s	Filter value for effective power in L1
Filter effective power L2	2	0..65535	s	Filter value for effective power in L2
Filter effective power L3	2	0..65535	s	Filter value for effective power in L3
Filter reactive power L1	2	0..65535	s	Filter value for reactive power in L1
Filter reactive power L2	2	0..65535	s	Filter value for reactive power in L2
Filter reactive power L3	2	0..65535	s	Filter value for reactive power in L3
Filter apparent power L1	2	0..65535	s	Filter value for apparent power in L1
Filter apparent power L2	2	0..65535	s	Filter value for apparent power in L2
Filter apparent power L3	2	0..65535	s	Filter value for apparent power in L3
Filter current L1	2	0..65535	s	Filter value for current in L1
Filter current L2	2	0..65535	s	Filter value for current in L2
Filter current L3	2	0..65535	s	Filter value for current in L3
Filter voltage L1	2	0..65535	s	Filter value for voltage in L1
Filter voltage L2	2	0..65535	s	Filter value for voltage in L2
Filter voltage L3	2	0..65535	s	Filter value for voltage in L3
Filter frequency L1	2	0..65535	s	Filter value for frequency in L1

1) Only the actually used measuring range must be set up.
L2 and L3 only for AD-LU 610

Device functions

Name	Works	Range	Unit	Comment
Allocation limiting value	„total effective power“	„effective power L1“, „effective power L2“, „effective power L3“, „reactive power L1“, „reactive power L2“, „reactive power L3“, „apparent power L1“, „apparent power L2“, „apparent power L3“, „current L1“, „current L2“, „current L3“, „voltage L1“,		Allocation of a measuring magnitude to limiting value editing. The measuring magnitude selected here is used for limiting value editing.

		„voltage L2“, „voltage L3“, „frequency L1“, „total effective power“, „total reactive power“, „total apparent power“, „power factor“		
Switch points lower upper	 0.1 0.2		 kW kW	Input of lower and upper switch point. 1)
Impulse valence	1	1..65535	Imp/kWH	Impulse valence of the S0-output. 2)
Impulse length	250	50..65535	ms	Impulse length of the output impulse. 2)
Back feed	„indicate back feed in L1 AND L2 AND L3“,	„indicate feeding back in L1“, „indicate feeding back in L2“, „indicate feeding back in L3“, „indicate feeding back in L1 OR L2 OR L3“, „indicate feeding back in L1 AND L2 AND L3“,		States, which type of energy feeding back into the mains is to be monitored. 3)

1) Is only edited, if parameter is „allocation relay“ = „limiting value“. The unit is dependent on paramter „allocation limiting value“.
2) Is only edited, if parameter is „allocation relay“ = „S0“.
3) Is only edited, if parameter is „allocation relay“ = „monitoring“.
L2, L3 and relay function only for AD-LU 610

Outputs

Name	Works	Range	Unit	Comment
Allocation current output	„total effective power“	„effective power L1“, „effective power L2“, „effective power L3“, „reactive power L1“, „reactive power L2“, „reactive power L3“, „apparent power L1“, „apparent power L2“, „apparent power L3“, „current L1“, „current L2“, „current L3“, „voltage L1“, „voltage L2“, „voltage L3“, „frequency L1“, „total effective power“, „total reactive power“, „total apparent power“, „power factor“		Allocation of a measuring magnitude to current output. The measuring magnitude selected here is imaged linear onto the current ouput.
Current output	0..20	0..20	mA	Current emitting range. The

range				input magnitude selected under „allocation current output" is here emitted.
Allocation voltage output	„total effective power"	„effective power L1", „effective power L2", „effective power L3", „reactive power L1", „reactive power L2", „reactive power L3", „apparent power L1", „apparent power L2", „apparent power L3", „current L1", „current L2", „current L3", „voltage L1", „voltage L2", „voltage L3", „frequency L1", „total effective power", „total reactive power", „total apparent power", „power factor"		Allocation of a measuring magnitude to voltage output. The measuring magnitude selected here is imaged linear onto the voltage output.
Voltage output range	0..10	0..10	V	Voltage emmission range. The input magnitude selected under „allocation voltage output" is here emitted.
Allocation relay	„Relay off"	„Relay off" „limiting value" „S0" „monitoring"		Allocation of a function to the relay output.
Working of relay	„work current"	„working current" „zero-signal current"		At „work current", the relay operates when the upper switch point is exceeded and at „zero-signal current " it releases.
Delay relay	0	0..65535	ms	Switching delay for switch-on and switch-off of the relay.

L2, L3 and relay function only for AD-LU 610

Device functions

Filtering the input signal

The input signal is converted to a digital value via an analogue digital transducer and is digitally filtered prior to any further processing. The raw value of the A/D-transducer is filtered at each programme run-through with the following function:

$$X_t = \frac{X_t + X_{t-1} * (F-1)}{F}$$

whereby X is the A/D-transducer value, t is the time of the current measuring, t-1 is the time of the last measuring and F is the filter value. The connection between the filter digit F and the transient period of 90% of the final value with a jump of the input signal from 0% to 100% is

$$t_{90} = F * 2{,}2 \; 6 * t_Z$$

whereby t_Z is the cycle time of the measuring value acquisition. The cycle time at the power measuring and at the power factor measuring derived from this is PF 2s. The currents, voltages and the frequency are ascertained in a mains period.

F	t90/s for power, PF	t90/s for currents, voltages, frequency mains frequency = 50Hz, tz = 20ms
1	4.,52	0,0452
2	9,04	0,0904
3	13,56	0,1356
4	18,08	0,1808
5	22,6	0,2260

Monitoring the input signal

The input signal is permanently monitored by the device. The frequency of the phase voltage of L1 serves as criteria. If the frequency of L1 is smaller than 40Hz for longer as one second, it is interpreted as mains failure and the device goes into error condition:

- The analogue signals are set to the emitting range start.
- The relay is switched off.
- The green mains LED flashes with approx. 1Hz.

If the frequency is again greater as 40Hz for longer as one second, the device goes again into normal operation.

Measuring power back fed into the mains

The power fed back to the mains during generator operation lies in the device as negative power. If this power is also to be acquired at the analogue output, the input must be scaled accordingly.
Example:
Measuring range total effective power = -100kW..+100kW
Output range = 0..20mA
The device would now emit 0mA during back feeding of -100kW into the mains, without power 10mA and with a power intake of +100kW 20mA.

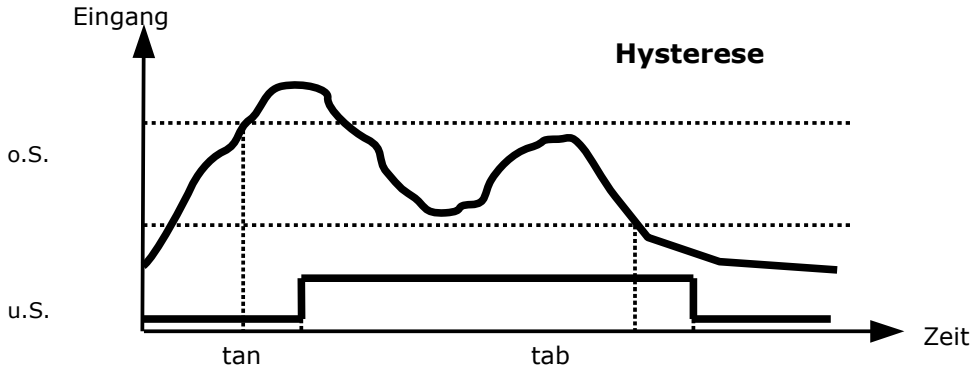
Relay functions

Alternatively, one of the three relay functions can be set for AD-LU 610 GA and AD-LU 610 GVF:

- Limiting value, limiting value editing of the selected input measuring magnitudes.
- S0. output of energy impulses for energy meter.
- Monitoring, indication of the energy flow direction through the relay.

Relay function limiting value

The limiting value function bevomes active, when the measuring vlaue has exceeded the upper switch point and the operating delay tan has expired. It becomes passive again, when it falls below the lower switch point and the release delay tab has expired. The terms „active" and „passive" refer to the logic of the limiting value funciton. Whether the relay operates or releases during active function depends on the setting of the mode of action for the relay. Work current means here operating at active function and not operating at non-active function. With zero-signal current it is exactly reversed.



To utilise the limiting value function, the following parameter must be set.

Parameter	Comment
„Allocation limiting value"	The input magnitude to be monitored must be selected here.
„Switch points"	Input of upper and lower switch point.
„Allocation relay" = „limiting value"	The limiting value function must be allocated to the relay here.
„Mode of operation relay"	Here it is possible to set whether the relay works in work current or in zero-signal current.
„Delay relay"	Here a possibly required operating delay and release delay can be entered.

Relay function S0

With the relay function „S0", the relay output can be used to emit energy impulses, which then can be counted and/or indicated by a downstream counter. During this, the effective power of the total network is considered.
To use the function „S0", the following paramter must be set.

Parameter	Comment
„Impulse valence"	Here the impulse valence of the emitted impulse can be altered.
„Impulse length"	Here, the implulse length of the emitted impulse can be altered.
„Allocation relay" = „S0"	Here, the S0-function must be allocated to the relay.

Monitoring the relay function

With the relay function „monitoring", the relay output can be used to indicate the energy flow direction to monitor the energy, which is fed back into the mains.
To use the function „monitoring", the following parameter must be set.

Parameter	Comment
„Back feed"	Here, the type of the back feed to be monitored can be altered.
„Allocation relay" = „monitoring"	Here, the monitoring function must be allocated to the relay.

Connection diagrams

Inputs

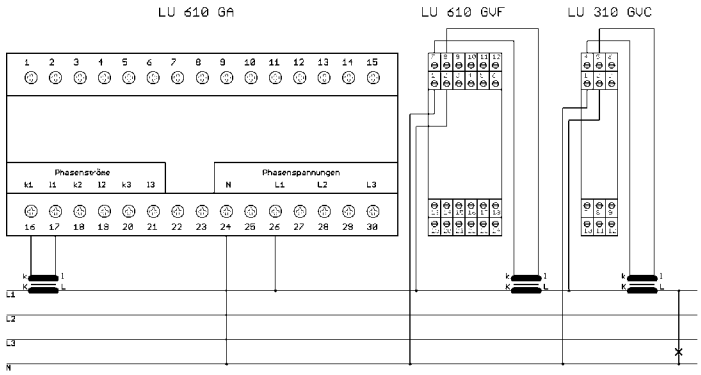


Figure 1: connection for alternating current.

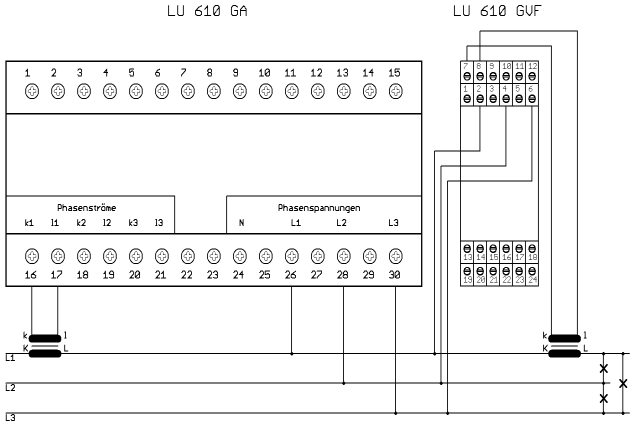


Figure 2: connection for three-conductor three-phase current even load.

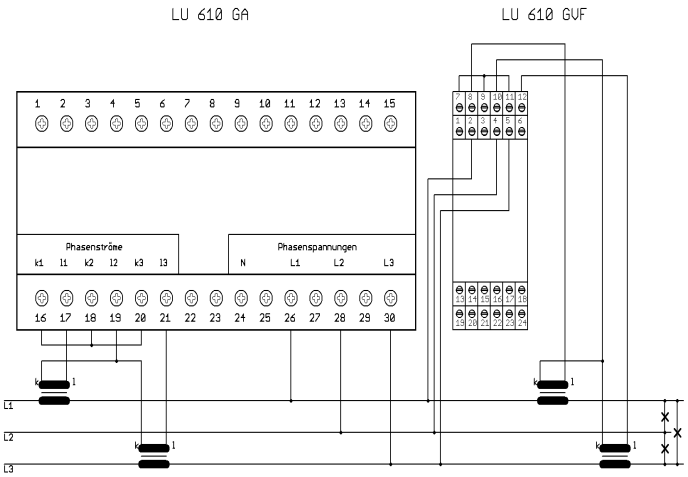


Figure 3: connection for three-conductor three-phase current any load.

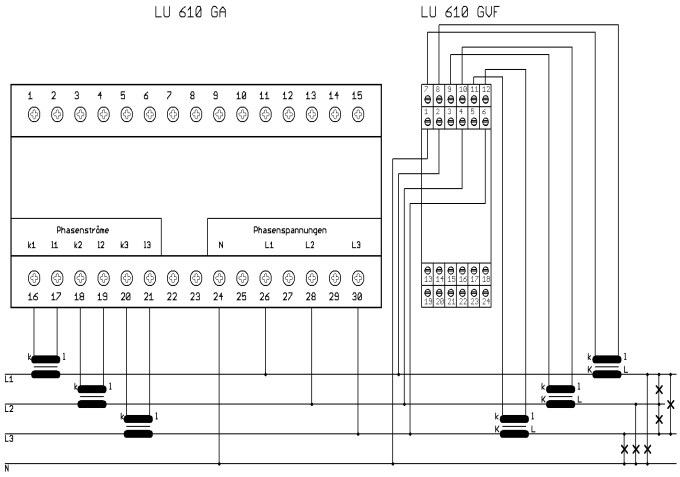


Figure 4: connection for four-conductor three-phase current uneven load.

Outputs

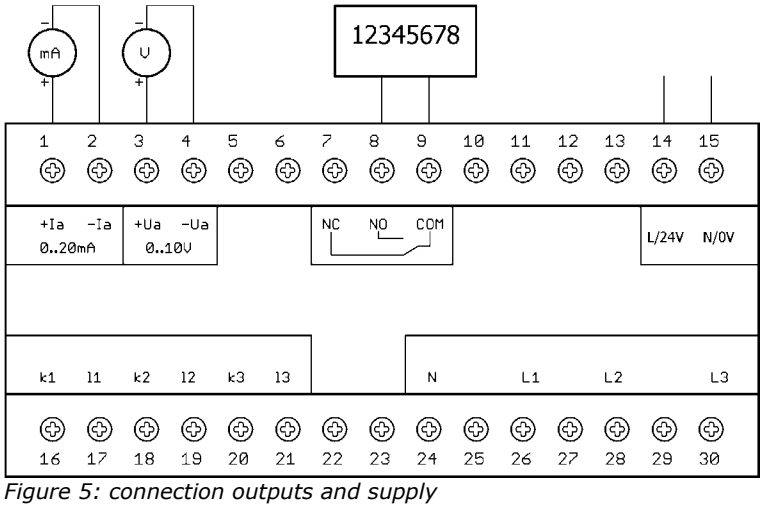


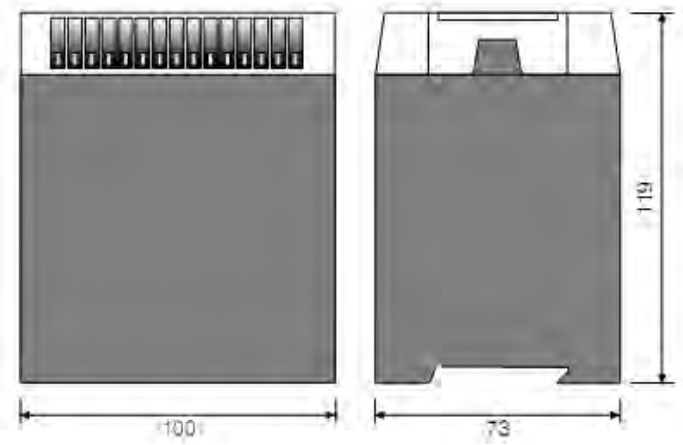
Figure 5: connection outputs and supply

Terminal allocation AD-LU 610 GA

Terminal	Function
1	Signal output current 0..20mA +
2	Signal output current 0..20mA - 1)
3	Signal output voltage 0..10V +
4	Signal output voltage 0..10V – 1)
5	-
6	-
7	Relay contact opener
8	Relay contact closer
9	Relay contact common
10	-
11	-
12	-
13	-
14	Auxiliary voltage AC/DC, non-polarized
15	Auxiliary voltage AC/DC, non-polarized
16	k1 current input direct or transducer, 5A
17	l1 current input direct or transducer, 5A
18	k2 current input direct or transducer, 5A
19	l2 current input direct or transducer, 5A
20	k3 current input direct or transducer, 5A
21	L3 current input direct or transducer, 5A
22	-
23	-
24	N Neutral conductor in the three-phase mains
25	-
26	L1 first phase in the three-phase mains
27	-
28	L2 second phase in the three-phase mains
29	-
30	L3 third phase in the three-phase mains

1) When using both outputs, there must not exist a galvanic connection between these terminals

Dimension diagram AD-LU 610 GA

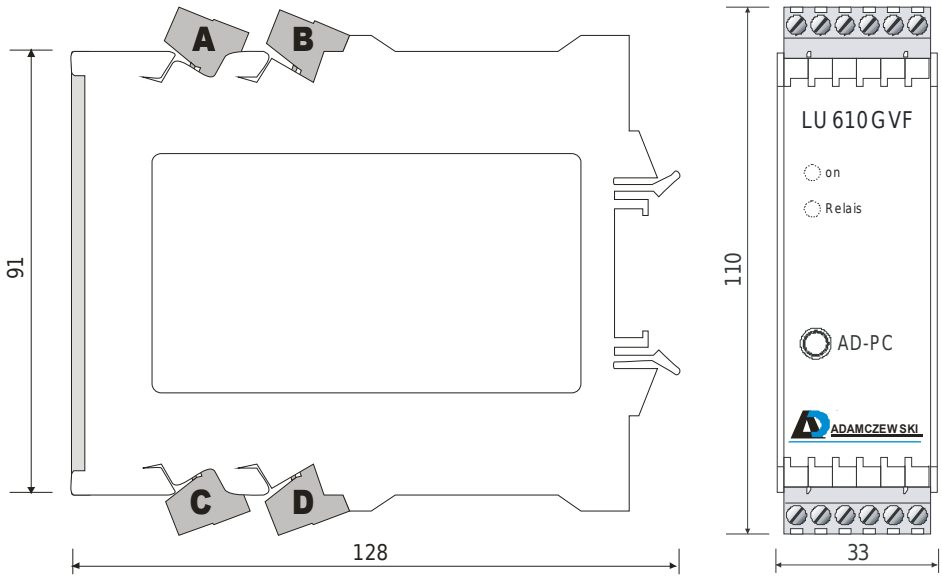


Terminal allocation AD-LU 610 GVF

Terminal	Function
1	N neutral conductor in the three-phase mains
2	L1 first phase in the three-phase mains
3	-
4	L2 second phase in the three-phase mains
5	-
6	L3 third phase in the three-phase mains
7	k1 current input direct or transducer, 5A
8	l1 current input direct or transducer, 5A
9	k2 current input direct or transducer, 5A
10	l2 current input direct or transducer, 5A
11	k3 current input direct or transducer, 5A
12	l3 current input direct or transducer, 5A
13	Signal output current 0..20mA +
14	Signal output current 0..20mA - 1)
15	Signal output voltage 0..10V +
16	Relay contact opener
17	Relay contact closer
18	Relay contact common
19	Auxiliary voltage AC/DC, non-polarized
20	Auxiliary voltage AC/DC, non-polarized
21	Signal output voltage 0..10V - 1)
22	-
23	-
24	-

1) When using both outputs, there must not exist a galvanic connection betwen these terminals

Dimension diagram AD-LU 610 GVF

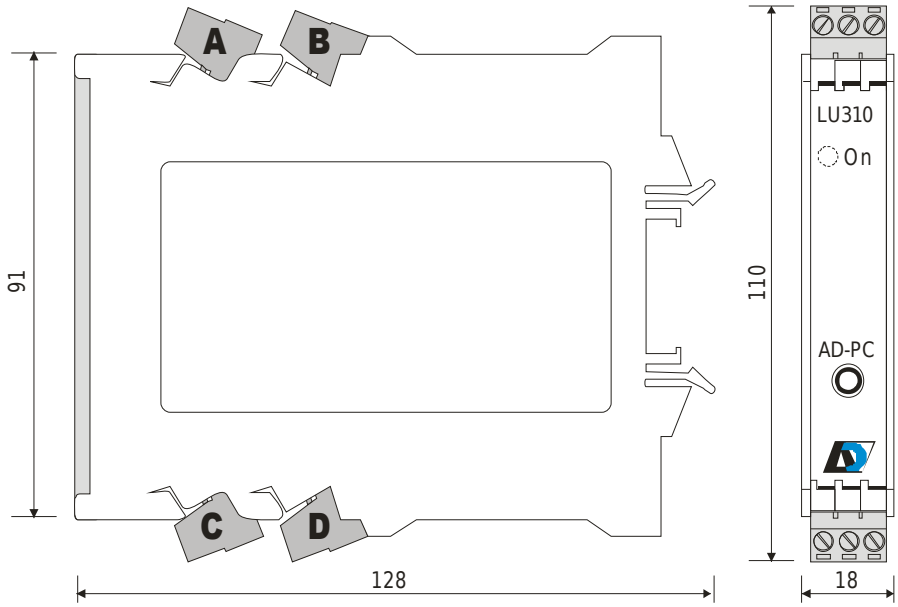


Terminal allocation AD-LU 310 GVC

Terminal	Function
1	N neutral conductor in the three-phase mains
2	L1 first phase in the three-phase mains
3	-
4	k1 current input direct or transducer, 5A
5	l1 current input direct or transducer, 5A
7	Signal output current 0..20mA +
8	Signal output current 0..20mA - 1)
9	Signal output voltage 0..10V +
10	Auxiliary voltage AC/DC, non-polarized
11	Auxiliary voltage AC/DC, non-polarized
12	Signal output voltage 0..10V - 1)

1) When using both outputs, there must not exist any galvanic connection betwen these terminals.

Dimension diagram AD-LU 310 GVC



Revisions

Revision	Date	Comment
1.0.0	08.12.2009	Document created.
1.0.1	21.04.2010	Spelling errors at relay output corrected.
2.0.0	04.04.2011	Devices AD-LU 610 GVF and AD-LU 310 GVC added.
2.0.1	18.08.2011	Name of the configuring programme VarioConfig replaced by AD-Studio. Chapter „Measuring of power fed back into mains“ added. Alteration of the paramter limiting values for the power in the negative range.