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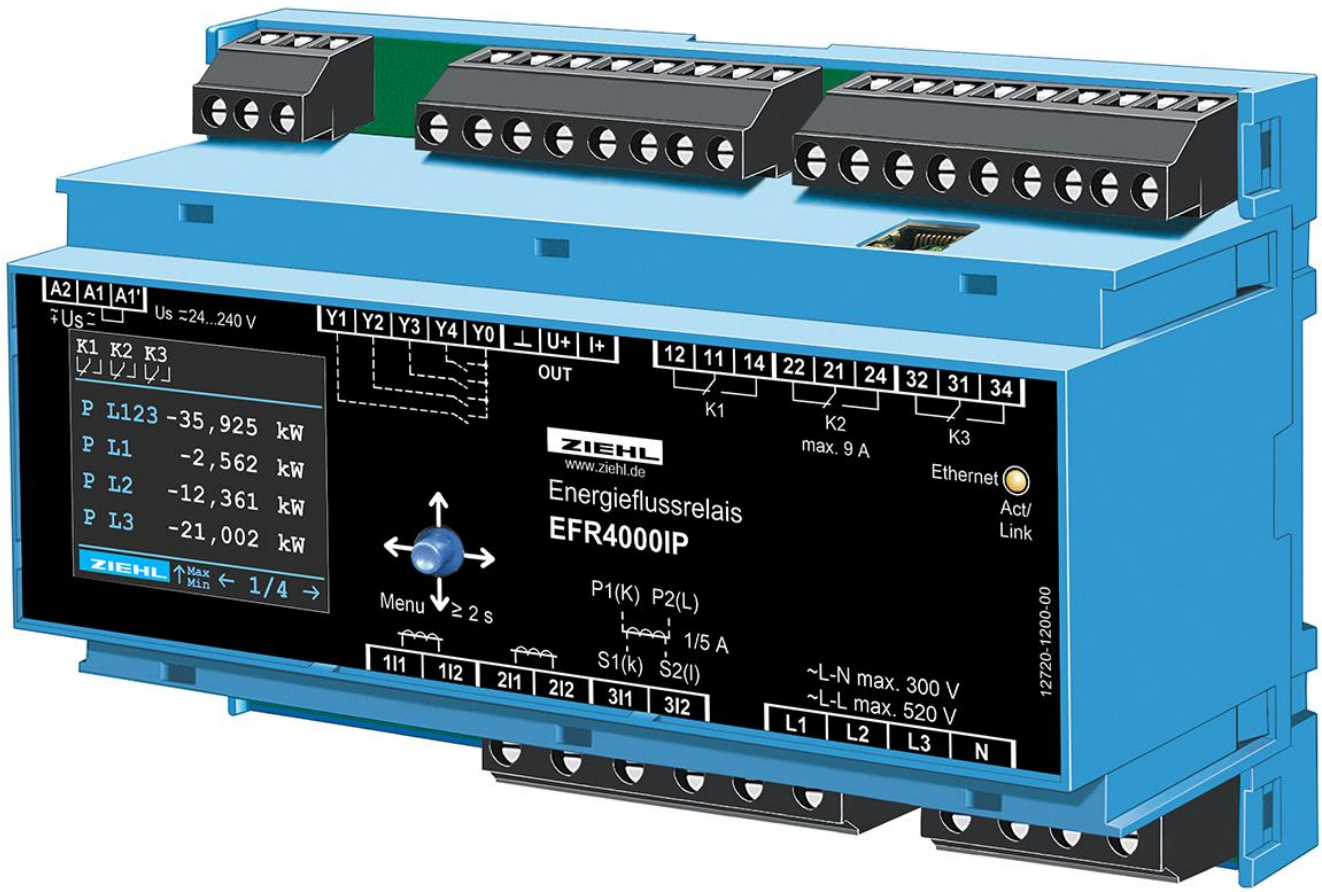
Operating Manual EFR4000IP

updated: 2020-06-04 / Um
from Firmware: 0-03

Energy flow relay with Ethernet
- certified Pav,e monitoring (configuration file available for download)
- Optimization of the internal consumption of self-generated energy
- Energy flow direction relay for battery storage systems (zero export / import device < 0.5s)
- Limitation of the infeed power
- 0 / 4 / 0-10 … 20 mA output with linear control function or as a scalable instrument transformer
- 0 / 2 / 0-5 … 10 V output with linear control function or as a scalable instrument transformer
- SG ready optimized
- Ethernet interface with integrated webserver for viewing the measured values, parametrizing and firmware update, Modbus TCP
- manual switching commands via digital input or web interface



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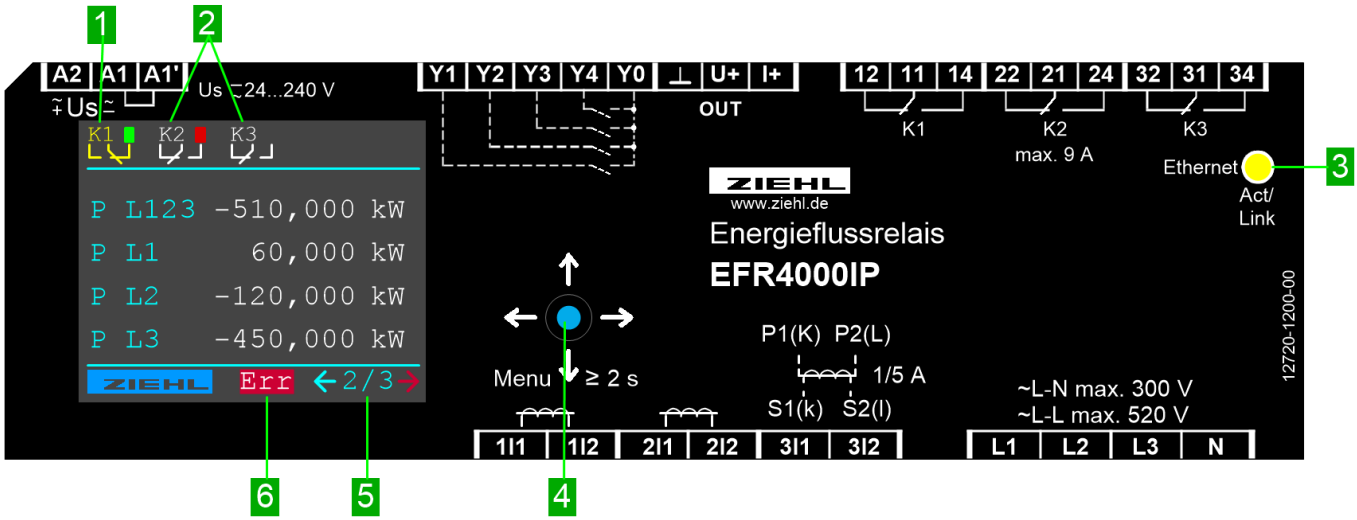
1 Display and controls



1 Relay K1 actuated (11 – 14),
Green time bar = load change is detected

2 Relays K2 & K3 de-energised (21 – 22; 31 – 32),
Red time bar = delayed on/off operational or load not detected

3 LED for ethernet activity / connection

4 Joystick button (special functions are displayed in the Err space)

5 Current display page / number of display pages / short-cuts for menu item

6 Error present, for display with help text navigate to the right (red arrow)

2 Factory setting Pr1 … 4

* factory setting

Menu	Parameter / Unit		Pr1 largest only 1-stufig	Pr2 largest combination 3-stufig	Pr3 largest combination 7-stufig	Pr4* fixed sequence K1-K2-K3	Users Data
Current-transformer	Primary	A	60	60	60	60	A
	Secondary	A	1	1	1	1	A
Relay	power at K1	kW	1,00	1,00	1,00	1,00	kW
	power at K2		2,00	2,00	2,00	2,00	kW
	power at K3		3,00	3,00	3,00	3,00	kW
	phase K1	Ph.	L1	L1	L1	L1	Ph
	phase K2		L2	L2	L2	L2	Ph
	phase K3		L3	L3	L3	L3	Ph
	load on K1		11-14	11-14	11-14	11-14	
	load on K2		21-24	21-24	21-24	21-24	
	load on K3		31-34	31-34	31-34	31-34	
	auto Reset K1		-	-	-	-	
	auto Reset K2		-	-	-	-	
	auto Reset K3		-	-	-	-	
Times	delay on K1	time	00:05:00	00:05:00	00:05:00	00:05:00	hh : mm : ss
	delay on K2		00:04:30	00:04:30		00:04:30	hh : mm : ss
	delay on K3		00:04:00	00:04:00		00:04:00	hh : mm : ss
	min on K1		00:05:00	00:05:00	00:05:00	00:05:00	hh : mm : ss
	min on K2		00:05:00	00:05:00		00:05:00	hh : mm : ss
	min on K3		00:05:00	00:05:00		00:05:00	hh : mm : ss
	delay off K1		00:03:00	00:03:00	00:03:00	00:03:00	hh : mm : ss
	delay off K2		00:03:30	00:03:30		00:03:30	hh : mm : ss
	delay off K3		00:04:00	00:04:00		00:04:00	hh : mm : ss
	load step K1		00:01:00	00:01:00	-	00:01:00	hh : mm : ss
	load step K2		00:01:00	00:01:00	-	00:01:00	hh : mm : ss
	load step K3		00:01:00	00:01:00	-	00:01:00	hh : mm : ss
Limits	power K1 on	kW	-1,20	-1,20	-	-1,20	kW
	power K1 off		-0,10	-0,10	-	-0,10	kW
	power K2 on		-2,20	-2,20	-	-2,20	kW
	power K2 off		-0,10	-0,10	-	-0,10	kW
	power K3 on		-3,20	-3,20	-	-3,20	kW
	power K3 off		-0,10	-0,10	-	-0,10	kW
	limit off		-	-	-0,50	-	kW
Digital inputs	Y0-Y1		Off	Off	Off	Off	
	Y0-Y2		Off	Off	Off	Off	
	Y0-Y3		Off	Off	Off	Off	
	Y0-Y4		Off	Off	Off	Off	
Analog output I	function		kW-L123	kW-L123	kW-L123	kW-L123	
	mode		0-20 mA	0-20 mA	0-20 mA	0-20 mA	
	individual Zero		0 mA	0 mA	0 mA	0 mA	mA
	Zero	kW	10,00	10,00	10,00	10,00	kW
	full scale		-10,00	-10,00	-10,00	-10,00	kW
	target value		-0,10	-0,10	-0,10	-0,10	kW
	max. power		1,00	1,00	1,00	1,00	kW
	regulation speed	%	90	90	90	90	%
	regul. interval	s	0,5	0,5	0,5	0,5	s
	regul. tolerance	%	5	5	5	5	%
Analog output U	function		kW-L123	kW-L123	kW-L123	kW-L123	
	mode		0-10 V	0-10 V	0-10 V	0-10 V	
	individual Zero		0 V	0 V	0 V	0 V	
	Zero	kW	10,00	10,00	10,00	10,00	kW

* factory setting			Pr1	Pr2	Pr3	Pr4*	
Menu	**Parameter / Unit**		largest only 1-stufig	largest combination 3-stufig	largest combination 7-stufig	fixed sequence K1-K2-K3	**Users Data**
Analog output U	full scale	kW	-10,00	-10,00	-10,00	-10,00	kW
	target value		-0,10	-0,10	-0,10	-0,10	kW
	max. power		1,00	1,00	1,00	1,00	kW
	regulation speed	%	90	90	90	90	%
	regul. interval	s	0,5	0,5	0,5	0,5	s
	regul. tolerance	%	5	5	5	5	%
Program & Code	program no.		1	2	3	4	
	default setting		No	No	No	No	
	code lock		Off	Off	Off	Off	
Network	DHCP		On	On	On	On	
	IP-adress		0.0.0.0 – 255.255.255.255				
	subnetmask						
Options	language		English	English	English	English	
	brightness	%	50	50	50	50	%
	dimming time	time	00:05:00	00:05:00	00:05:00	00:05:00	hh : mm : ss
	display interval	s	0,5	0,5	0,5	0,5	s
Info	firmware Version		0-00	0-00	0-00	0-00	
	serial number		-	-	-	-	

3 Factory setting Pr5 + 6 (Pav,e and zero export / import device)

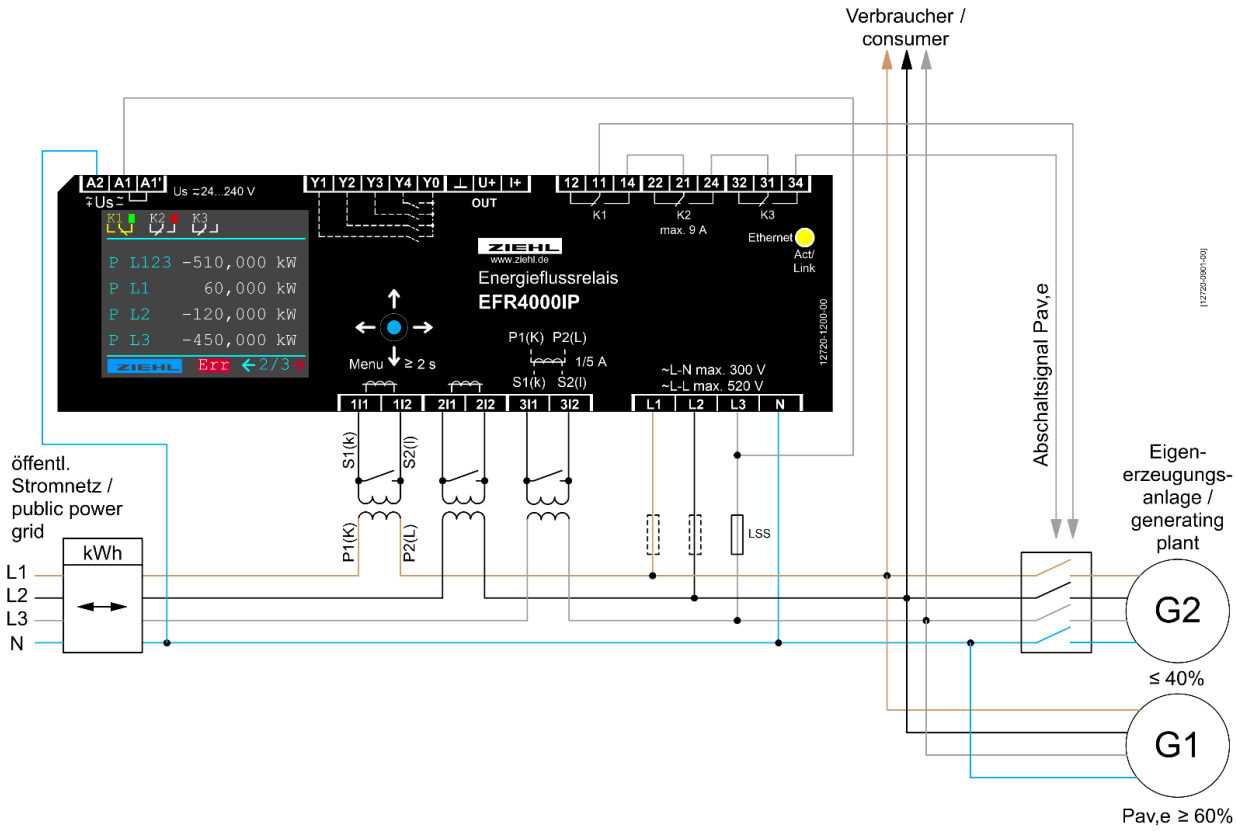
* factory setting zero export device			Pr5	Pr5	Pr6		
Menu	**Parameter / Unit**		zero exp. sum	Pav,e**	zero exp. 1 of 3*		**Users Data**
Current transformer	primary	A	60	60	60		A
	secondary	A	1	1	1		A
Relay	phase K1		-	-	L123		
	phase K2		-	-	L123		
	phase K3		-	-	L123		
	auto Reset K1		Off	On	Off		
	auto Reset K2		Off	On	Off		
	auto Reset K3		Off	On	Off		
Times	delay off K1	time	00:00,10	00:09,30	00:00,10		mm : ss , ss
	delay off K2		00:00,10	00:02,60	00:00,10		mm : ss , ss
	delay off K3		00:00,10	00:00,00	00:00,10		mm : ss , ss
	delay on K1		00:00:10	00:01:00	00:00:10		hh : mm : ss
	delay on K2		00:00:10	00:01:00	00:00:10		hh : mm : ss
	delay on K3		00:00:10	00:01:00	00:00:10		hh : mm : ss
Limits	power K1 on	kW	0,50	-9,80	0,50		kW
	power K1 off		0,10	-10,20	0,10		kW
	power K2 on		-0,50	-9,80	-0,50		kW
	power K2 off		-0,10	-10,67	-0,10		kW
	power K3 on		0,70	-9,80	0,70		kW
	power K3 off		0,30	-16,90	0,30		kW
Digital inputs	Y0-Y1		Reset	Reset	Reset		
	Y0-Y2		Reset	Reset	Reset		
	Y0-Y3		Reset	Reset	Reset		
	Y0-Y4		Reset	Reset	Reset		

** configuration file for download

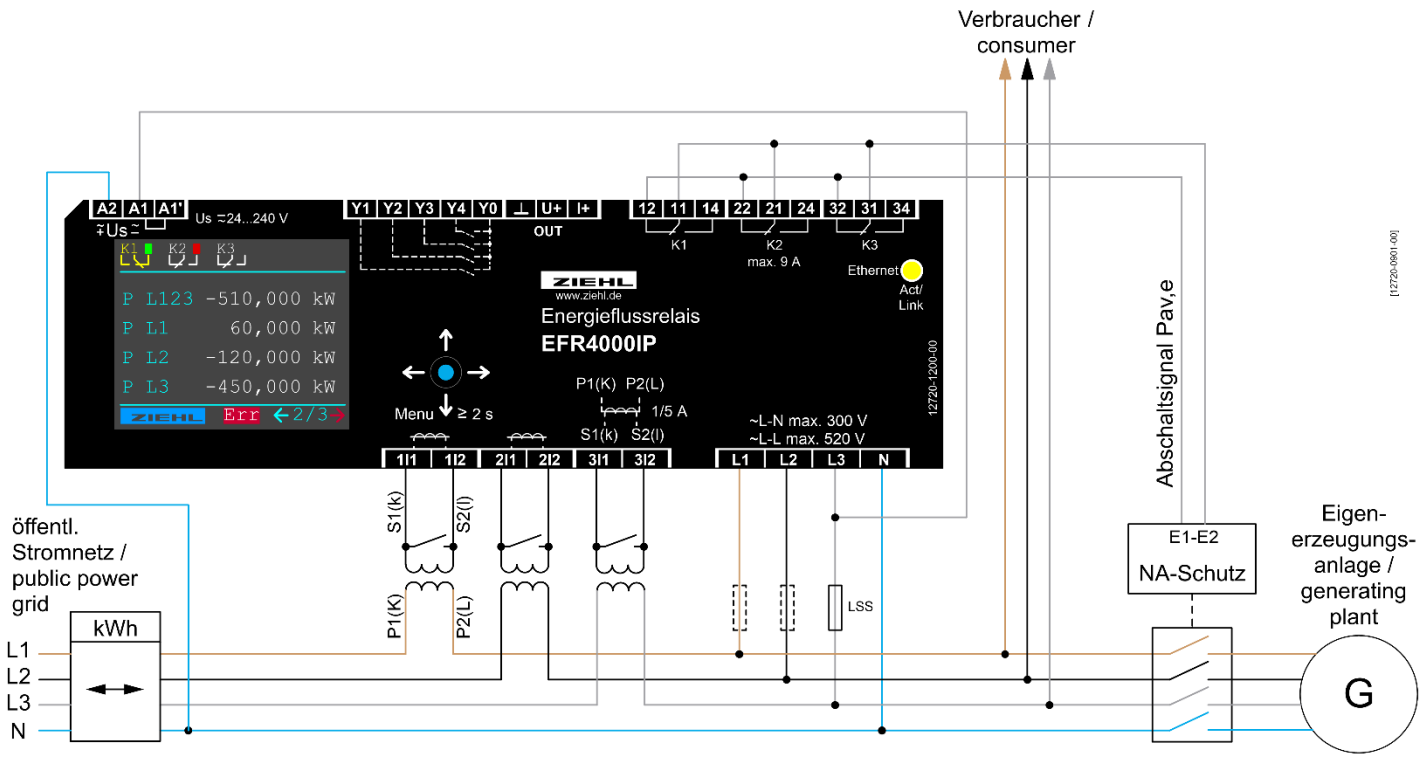
* factory setting zero export device			Pr5	Pr5	Pr6		
Menu	**Parameter / Unit**		zero exp. sum	Pav,e	zero exp. 1 of 3*		**Users Data**
Analog output I	function		kW-L123	kW-L123	kW-L123		
	mode		0-20 mA	0-20 mA	0-20 mA		
	individual Zero		0 mA	0 mA	0 mA		mA
	Zero	kW	10,00	10,00	10,00		kW
	full scale		-10,00	-10,00	-10,00		kW
	target value		-0,10	-0,10	-0,10		kW
	max. power		1,00	1,00	1,00		kW
	regulation speed	%	90	90	90		%
	regul. interval	s	0,5	0,5	0,5		s
	regul. tolerance	%	5	5	5		%
Analog output U	function		kW-L123	kW-L123	kW-L123		
	mode		0-10 V	0-10 V	0-10 V		
	individual Zero		0 V	0 V	0 V		V
	Zero	kW	10,00	10,00	10,00		kW
	full scale		-10,00	-10,00	-10,00		kW
	target value		-0,10	-0,10	-0,10		kW
	max. power		1,00	1,00	1,00		kW
	regulation speed	%	90	90	90		%
	regul. interval	s	0,5	0,5	0,5		s
	regul. tolerance	%	5	5	5		%
Program & Code	program no		5	5	6		
	default setting		No	No	No		
	code lock		Off	Off	Off		
Options	language		English	English	English		
	brightness	%	50	50	50		%
	dimming time	time	00:05:00	00:05:00	00:05:00		hh : mm : ss
	display interval	s	0,5	0,5	0,5		s
Info	firmware Version		0-00	0-00	0-00		
	serial number		-	-	-		

4 Connecting diagram

4.1 Pav,e monitoring, separate disconnection of system components

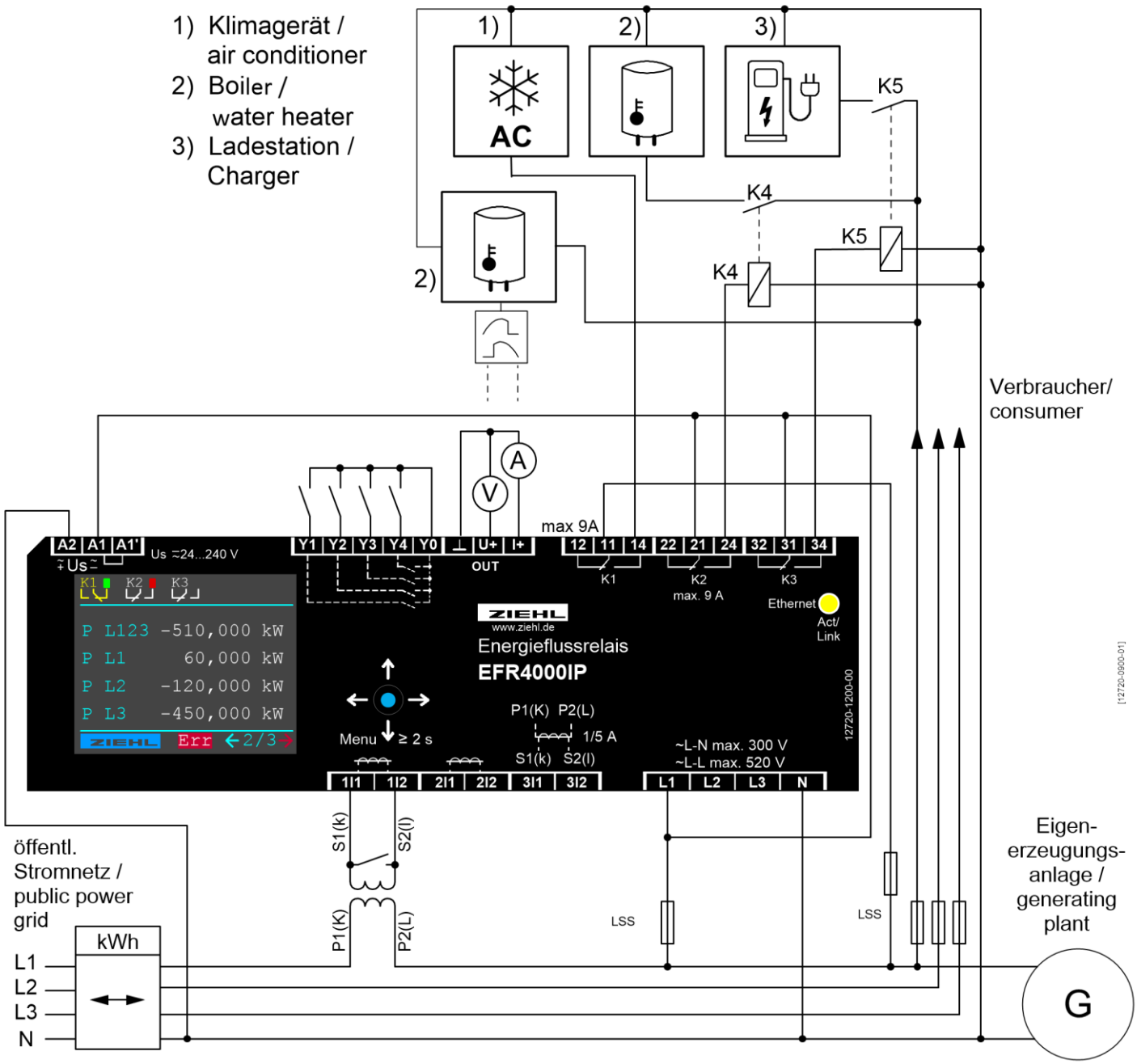


4.2 Pav,e monitoring, full disconnection via grid- and plant protection

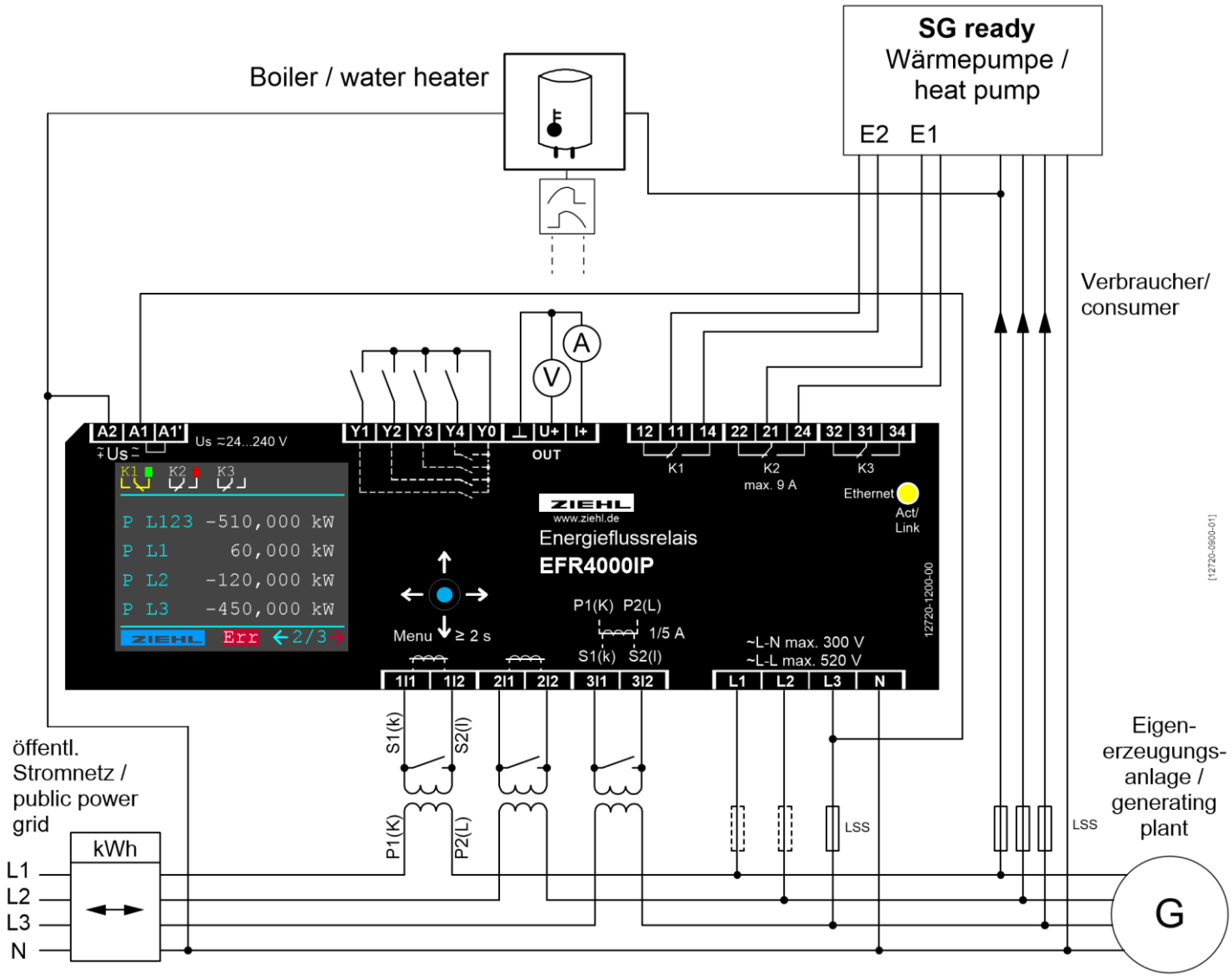


4.3 1x directly, 1x coupling relay 1 phase load, 1x coupling relay 3-phase load and controlled load to analogue output

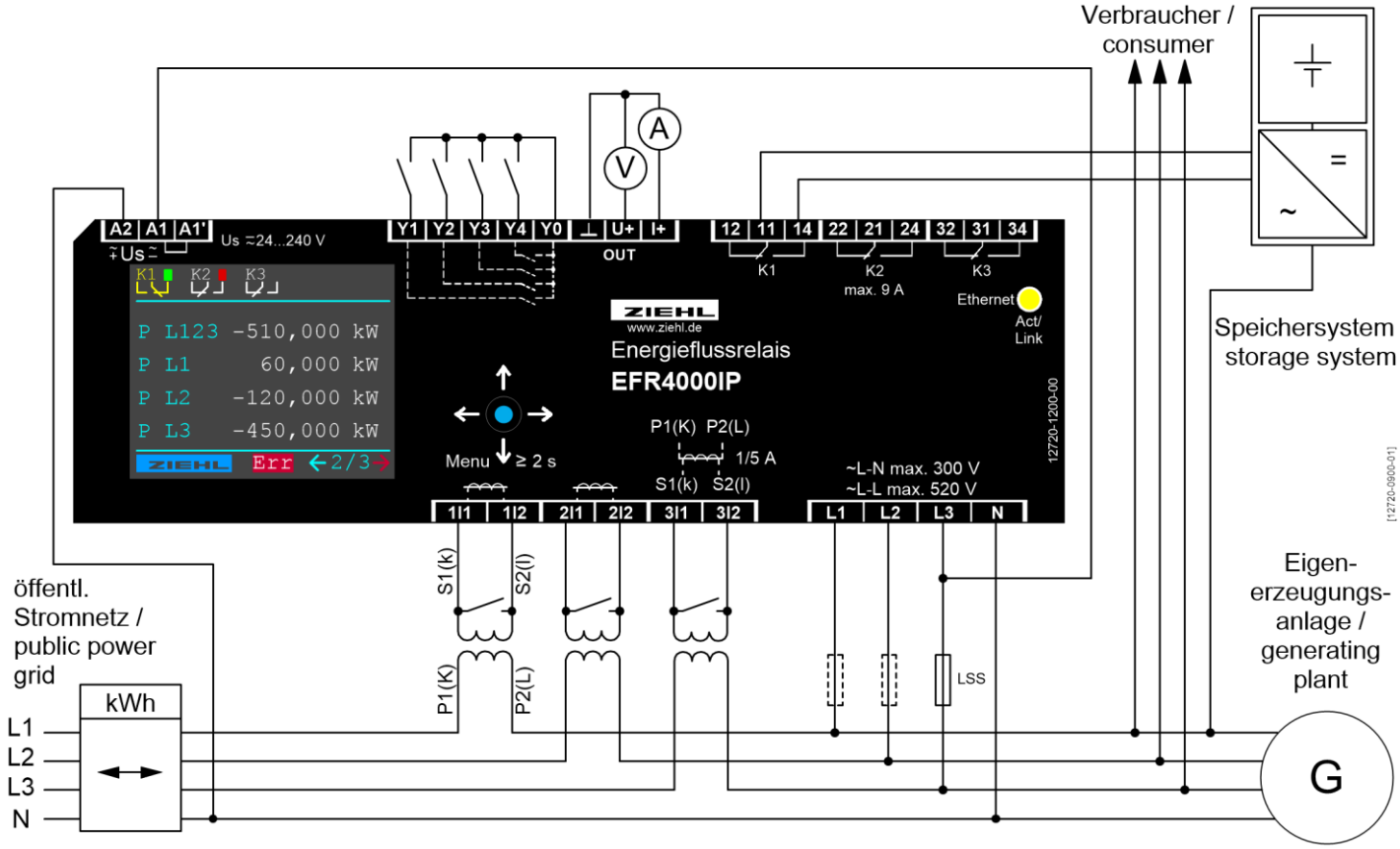
Info:
Loads / consumer up to max. 2kW (9A) can also be switched without coupling relays.



4.4 SG ready heat pump (operating condition 3 + 4, Pr4) and controlled load on analogue output

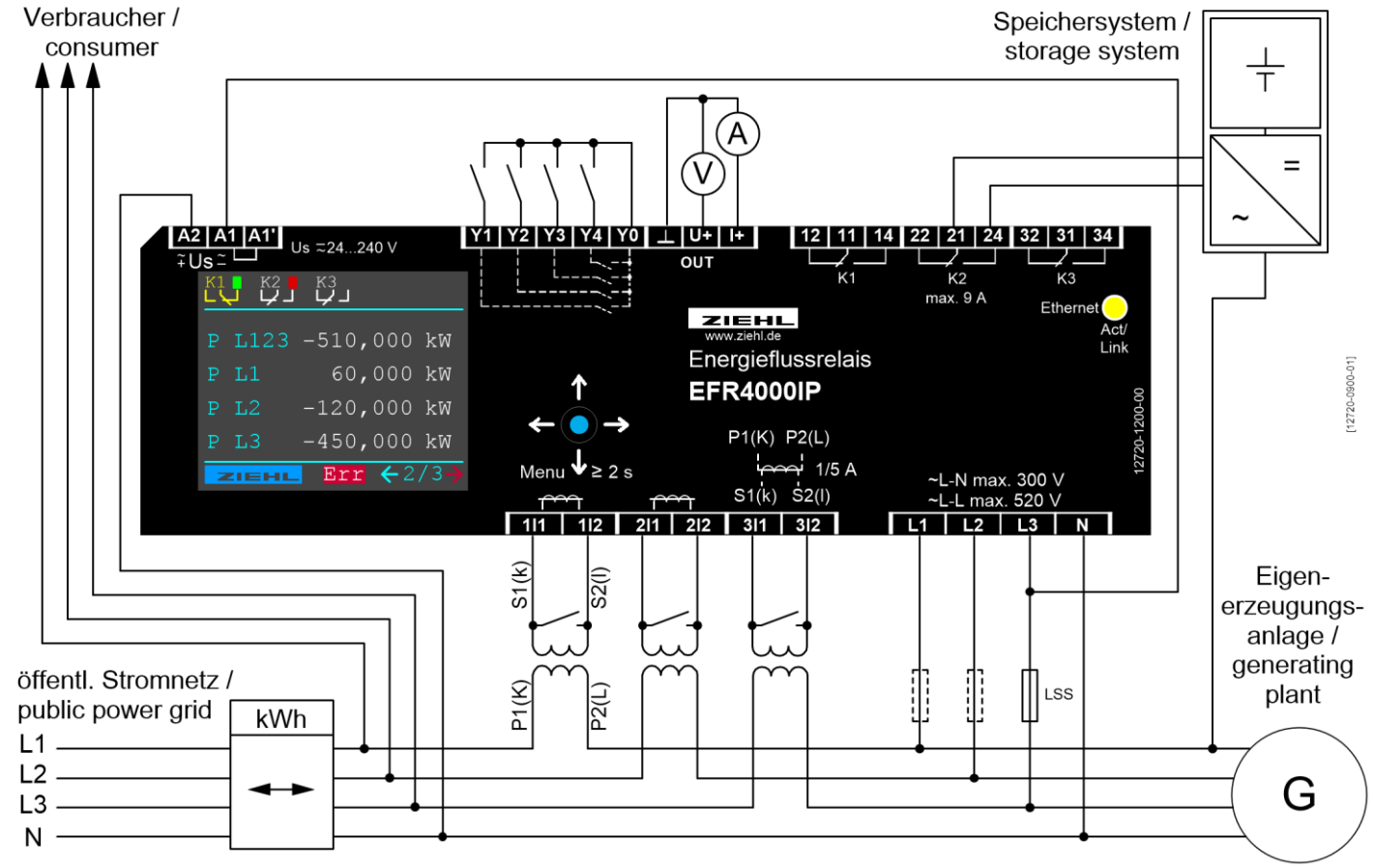


4.5 Energy flow direction relay (zero export device) without delivery into the public grid



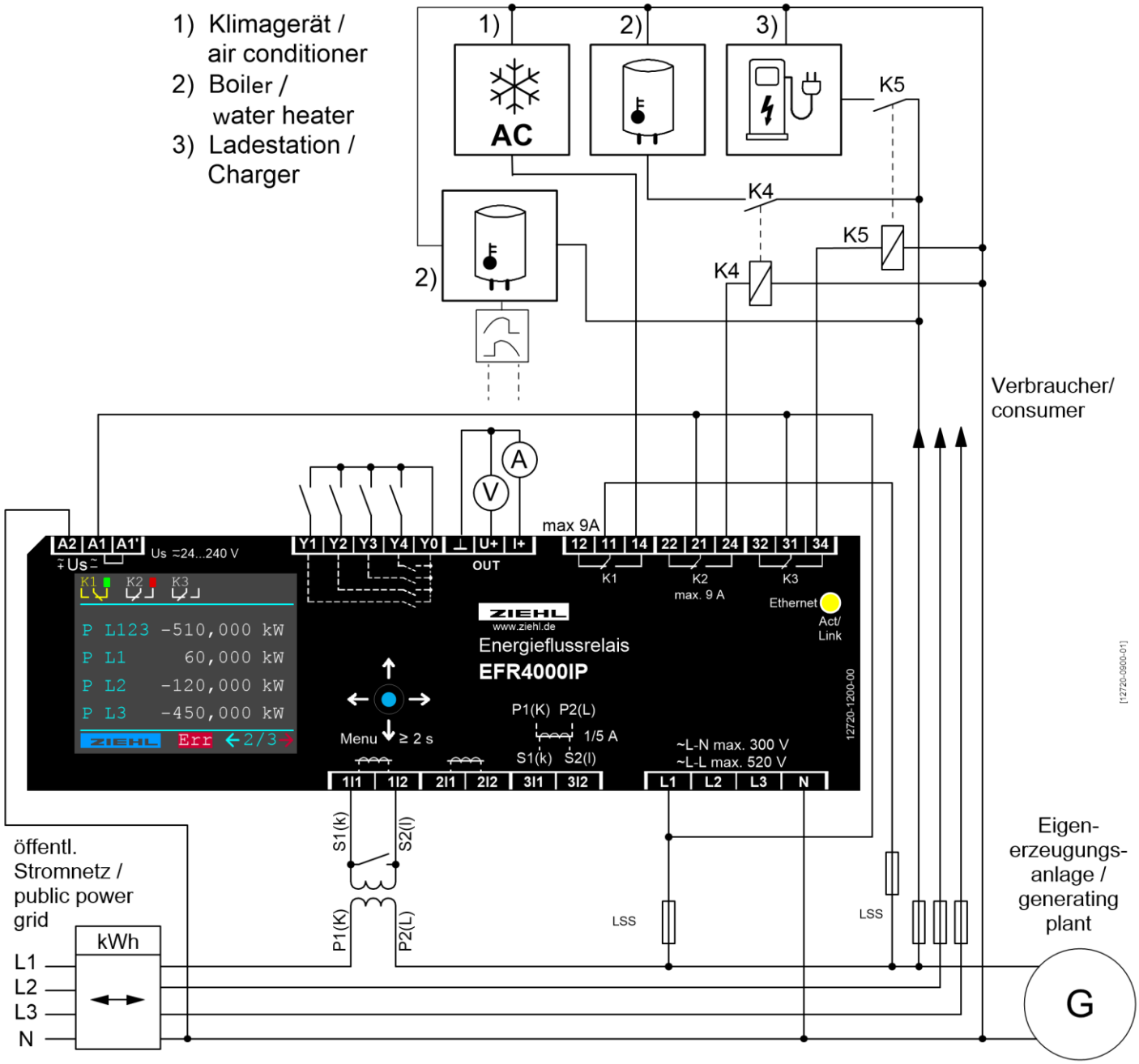
Info:
Set min. monitoring: power Kx off < power Kx on

4.6 Energy flow direction relay (zero import device) without delivery from the public grid



Info:
Set max. monitoring: power Kx off > power Kx on

4.7 1 phase connection to L1 (!)



Info:
Loads / consumer up to max. 2kW (9A) can also be switched without coupling relays.
Do not connect wires to unused measuring inputs!

4.8 Connection Ethernet (RJ45)

5 Important Information

DANGER!
Hazardous voltage!
Will cause death or serious injury. Turn off and lock out all power supplying this device before working on this device.

To use the equipment flawless and safe, transport and store properly, install and start professionally and operate as directed.
Only let persons work with the equipment who are familiar with installation, start and use and who have appropriate qualification corresponding to their function. They must observe the contents of the instructions manual, the information which are written on the equipment and the relevant security instructions for the setting up and the use of electrical units.
The equipment is built according to DIN / EN and checked and leave the plant according to security in perfect condition. If, in any case the information in the instructions manual is not sufficient, please contact our company or the responsible representative.
To maintain this condition, you must observe the safety instructions in this instruction manual titled "Important Information". Failure to follow the safety instructions may result in death, personal injury, or property damage to the equipment itself and other equipment and facilities.
Instead of the industrial norms and regulations written in this instruction manual valid for Europe, you must observe out of their geographical scope the valid and relevant regulations of the corresponding country.

The analogue output connections, Y0 … Y4 inputs and Ethernet have each other no isolation / insolation.
If a phase-angle control or trailing-edge control is connected to the analogue output (OUT U+ I+), this control must have a reinforced insulation / safe disconnection to the load / mains side.

A circuit-breaker or switch must be situated within easy reach of the unit and fused. Installation excess current protection should be ≤ 10 A.

When using phase-angle controllers / trailing-edge controllers comply with the specifications of the grid operator.

External current transformers:

- **External current transformers are required to measure currents.**
- **The secondary lines S1 (K) and S2 (L) must not be grounded.**
- **The secondary circuits of the current transformers must never be operated open (dangerous electrical voltage)**

For switching 3-phase rotating (motor-driven) loads, protection must be used.

6 Installation

- mount on 35 mm mounting rail according to EN 60715
- wall-mount with 3 x screws M4
- connecting wires refer to the connection plan to prevent miss-operation and malfunction.

7 Detailed description

7.1 Pav,e - monitoring

With Pav,e - monitoring by the EFR4000IP, it is possible to connect more generation capacity than is permissible for the grid connection point. Pav,e - monitoring serves as a feed-in limitation. The permissible active feed-in power Pav,e must be at least 60% of the installed active power Pinst of all generating plants.

e.g. Pav,e = 100 kW →Pinst max 166,7kW

In the past, full feeding plants were often designed with the maximum permissible feed power. Until now, this has meant that no further own-consumption plants could be added. In Germany new VDE-AR-N 4105: 2018-11 allows that under certain conditions installed generation capacity exceeds permissible maximum power that may be fed into the grid. To do this, the operator of the plant must ensure that the approved feed-in power is not exceeded. This can be done by consuming surplus power or by reducing it.

7.2 Optimization of the internal consumption of self-generated energy

The EFR4000IP measures the flow of energy in all 3 phases. If there is enough intrinsic power left, the EFR4000IP switches in up to three consumers and ensures that the current is consumed in-house. Potential consumers are, for example, air conditioning systems, hot water production or battery charging devices along with washing machines, dryers, etc... This is relatively easy if a PV system is feeding-in at a regular rate under clear skies and consumers with constant power consumption such as heat pumps or heating elements are connected. Consumers are particularly suitable that consume a lot of energy and which can be connected often, e.g. hot water generation. It is more complicated if the infeed varies due to clouds in front of the sun and consumers do not continuously consume power such as washing machines, dryers, irons or cookers. With the analogue output a consumer can be continuously regulated and thus the internal consumption can be further optimized. When using phase-angle controllers, the requirements of the network operators need to be observed.
The EFR4000IP makes it possible to optimize the internal consumption even under difficult conditions.

To accomplish that, the following parameters can be set:

- Power consumption of the connected consumer
- Operating points, the energy flow at which the consumers are switched on
- Switch-on delay of the consumers, Short reduction of consumption (also through clocked consumers) or peaks in the infeed do not immediately lead to switching in additional consumers
- Minimum start up time, Heat pumps must not be continuously turned on and off, washing machines should be able to conclude a washing cycle.
- Turn-off delay, Short consumption peaks or reduction at the infeed do not immediately lead to a consumer being switched off.
- Reset point, the energy flow at which the consumers are switched off again. In practice, this value usually lies slightly on the "power delivery" side.
- Hide inputs to consumers if they are not available, e.g. hot water boiler has reached the maximum temperature.

The power is always evaluated and displayed as seen from power meter:
Delivery from energy supplier is positive, the power fed into the grid reduces the electricity invoice and is therefore negative (- prefix).

7.3 Description of the connections

Connection	Description
A1, A1‘ and A2	Supply voltage DC/AC 24 … 240 V 0/50/60 Hz
Y0	Supply voltage for digital inputs, approx. 18V DC
Y1, Y2, Y3, Y4	Digital inputs, K1...3 external on or off, control the Analog outputs
RJ45	Ethernet and Modbus TCP interface
Out 20 mA: GND and I+	Analogue output 0/4…20 mA for adjustable loads or as instrument transformer
Out 10 V: GND U+	Analogue output 0/2…10 V for adjustable loads or as instrument transformer
12,11,14; 22,21,24; 32,31,34	Relays K1, K2 and K3 (max. 9A direct)
L1, L2, L3 and N	Voltage measurement, phase L1, L2, L3 and neutral conductor
1l1(k), 1l2(l); 2l1(k), 2l2(l); 3l1(k), 3l2(l)	Current measurement, phase L1, L2 and L3 (only through current transformers), k = secondary power plant, l = secondary load

7.4 Functional characteristics

<table>
<tr><td>Negative measured value for performance</td><td>+ : Reference
- : Supply (excess)</td></tr>
<tr><td>Priorities / Priority</td><td>Highest: Timer function (Web only)
Medium: Digital input (Y4 highest, Y lowest)
Lowest: Normal switching function</td></tr>
<tr><td>Consideration of connected loads/consumers</td><td>Depending on the selected program, connected loads / consumers are taken into account to identify internal connect / disconnect limits</td></tr>
<tr><td>Influence of delay times</td><td>Depending on the program, determines not only the limit of the connection sequence but also the set delay times
(larger load should have shorter time and therefore has priority)</td></tr>
<tr><td>Implement minimum run times (Min on)</td><td>Minimum run times of, e.g. heat pumps, washing machines, etc. can be implemented through the minimum start-up time (Times -> Min on Kx); once a load/consumer is switched on, shut-down is earliest after the set time</td></tr>
<tr><td>Implement minimum switch-off time
(delay on)</td><td>Minimum off time of, for example, heat pumps, etc. can be implemented through the delay ON time (Times -> delay on), this time runs out before the On consumer is switched on, the minimum switch off time of the consumer can be set, the delay ON time can also be set shorter</td></tr>
<tr><td>SG ready</td><td>In Program 4, the EFR4000IP also supports
SG ready devices / heat pumps:
<table>
<tr><th>Operating status</th><th>Signal K2 : K1</th><th>Description</th></tr>
<tr><td>3</td><td>0 : 1</td><td>Switch-on recommendation for enhanced operation</td></tr>
<tr><td>4</td><td>1 : 1</td><td>Definitive switch-on command</td></tr>
</table></td></tr>
<tr><td>Min / Max values</td><td>All the min and max values are stored zero voltage retentive; press the 2s button ↑ to delete the currently displayed min and max values</td></tr>
<tr><td>zero export / import device, relay function</td><td>In PR5+6 the relay position cannot be adjusted; the closed-circuit current principle always applies here i.e. the limit value is not exceeded/undercut = relay actuated (x1-x4)</td></tr>
<tr><td>zero export / import device, monitor function</td><td>In PR5+6 the set limit values determine the monitoring function of the associated relay:
Power Kx off > Power Kx on = MAX monitoring (exceed)
Power Kx off < Power Kx on = MIN monitoring (undercut)</td></tr>
</table>

7.5 Program 1 (the largest of up to 3 consumers is switched on)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- 1…3 switchable consumers, same / different power, e.g. heating element, heat pump, rechargeable batteries, electric car, electric heating, air conditioning, ...
- Max. 1 controllable consumer with linear phase angle or trailing-edge control 0/4 to 20 mA (0-10V), e.g. heating element
- 1 and / or 3-phase consumers

Goal:

- The highest possible internal consumption by switching-in the largest-possible consumer / load
- Taking into account the analogue consumed power it is possible to switch on a relay if the relay is switched on and the controlled consumer is reduced (relays have priority)

Measurement:

- The EFR4000IP monitors the accumulated flow of energy at the grid connection point (between the public power grid and the consumers / generators)

Feature:

- Consumers that are already switch on and the analogue controlled consumers are taken into account (which is why the typical power consumption of the consumers has to be set)

Connection:

- If the grid-infeed increase, the delivery falls under the limit-ON value which is set for the load or consumer, then the delay-ON time, set for the load, starts to count.
  If the limit value remains undercut for the entire time, the consumer is switched on and the set minimum-on time begins
- If the grid-infeed carry on to increase, the delivery continues to fall below the next largest consumer switch on, after the expiration of the set delay-ON time and minimum start-up time, the smaller consumer will be switch off and the larger one switch on.
- All consumers are switch on in the same way
- Thereby if sufficient power is available the largest possible consumer is switch on first it should be given the shortest delay-ON time (smallest = longest)

Disconnection:

- If the grid-infeed decreases and the delivery rise above the limit OFF value which is set for the load or consumer, then the delay-OFF time, set for the load, starts to count.
  If the limit value remains undercut for the entire time, the consumer is switch off after the minimum-on time has expired
- When switching back to the next lower level, the delay ON time does not run down again which efficiently uses the excess energy

Application Examples:

- 3 heating elements with different power, only one of them is allowed to be switch on at one time.
- Electric heating with 3 heating levels, only one of them is allowed to be switch on at the same time.

7.6 Program 2 (up to 3 consumers are switched on in succession)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- 1 up to 3 switchable consumers, same or different power, e.g. heating element, heat pump, rechargeable batteries, electric car, electric heating, air conditioning, ...
- Max. 1 controllable consumer with linear phase-angle or trailing-edge control 0/4 to 20 mA (0-10V)
- 1 and / or 3-phase consumers

Goal:

- Highest possible internal consumption by gradually switching on the consumers or loads, at the same time. The previously switched on consumers are still switched on.
- If it is possible to switch on a relay in consideration of analogue consumed power, the relay would turn on and the analogue controlled consumer is going to switch off. (priority in relays)

Measurement:

- The EFR4000IP monitors the amount flow of energy at the grid connection point (between the public power grid and the consumers / generators)

Feature:

- Analogue regulated consumers are taken into account
- Previously switch on consumers are not taken into account, the actually measured value P L123 is evaluated

Connection:

- If the grid-infeed increases and the delivery falls under the limit ON value, which is set for the consumer, then the delay-ON time, set for the load, starts to count. If the limit value remains undercut for the entire time, the consumer switch on and the set minimum-on time begin.
- If the grid-infeed carry on to increase, the delivery continues to fall below the setting limit the next largest consumer switch on after the expiration of the set delay-ON time.
- All consumers are switch on in the same way
- The sequence is determined by the set limit values and by the set delay ON times

Disconnection:

- If the infeed decreases / the delivery increases over the limit OFF value set for the load / consumer, the set delay OFF time starts; if the limit value remains exceeded for the entire time, the consumer is switched off after the expiration of the minimum start-up time
- All consumers are switched off the same way
- So that the smallest consumer is switched off first it should be given the shortest delay OFF time (largest = longest)

Example:

- Electric heating with 3 heat levels, all 3 can be operated at the same time but the sequence (low, medium, high) must be correct

7.7 Program 3 (largest load combination of 7-stages)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- 3 switchable consumers (otherwise Pr 2), different powers, e.g. heating element, electric heating, ...
- Is ideal for switching heating levels
- Max. 1 controllable consumer with linear phase angle or trailing-edge control 0/4 to 20 mA (0-10V)
- 1 and / or 3-phase consumers

Goal:

- The highest possible internal consumption by switching in the largest-possible load combination
- Taking into account the analogue consumed power it is possible to switch on a relay if the relay is switched on and the controlled consumer is reduced (relays have priority)

Measurement:

- The EFR4000IP monitors the accumulated flow of energy at the grid connection point (between the public power grid and the consumers / generators)

Feature:

- Analogue regulated consumers are taken into account
- Consumers that are already switched on are taken into account (which is why the typical power consumption of the consumer has to be set)

Connection:

- All 7 levels have a common SWITCH-OFF value and the same delay ON + OFF and minimum on time
- If the infeed increases / the delivery falls under the set SWITCH-OFF value + load size of the stages, the set delay ON time starts; if the limit value remains undercut for the entire time, the first consumer is switched on and the set minimum start-up time begins
- If the infeed increases / the delivery continues to fall so that the next largest combination could be switched on, after the expiration of the set minimum start-up time + delay ON time the smaller combination will be switch off and the larger one switch on
- All combinations are switched on the same way

Disconnection:

- If the infeed decreases / the delivery increases over the set SWITCH-OFF value, the set delay OFF time starts; if the SWITCH-OFF value remains exceeded for the entire time, the combination is switched off after the expiration of the minimum start-up time
- When switching back to the next lower level, the delay ON time does not run down again which efficiently uses the excess energy

Example:

3 heating elements with the same/different power; all 3 can be operated simultaneously

7.8 Program 4 (fixed starting sequence K1-K2-K3, SG ready)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- 1…3 switchable consumers, same / different power e.g. heating element, heat pump (also SG ready), rechargeable batteries, electric car, electric heating, air conditioning, ...
- Max. 1 controllable consumer with linear phase angle or trailing-edge control 0/4 to 20 mA (0-10V), e.g. heating element
- 1 and / or 3-phase consumers

Goal:

- Highest possible internal consumption by gradually switching in the consumers / loads in the fixed starting sequence K1 – K2 – K3, at the same time the previously switched on consumers / loads stay switched on
- The load at K2 is switched on earliest if K1 is switched on,
  the load to K3 is switched on earliest if K2 is switched on
- It is ensured that Consumer K1 is always first switched on, for example, generates hot water
- Taking into account the analogue consumed power it is possible to switch on a relay if the relay is switched on and the controlled consumer is reduced (relays have priority)

Measurement:

- The EFR4000IP monitors the accumulated flow of energy at the grid connection point
  (between the public power grid and the consumers / generators)

Feature:

- Analogue regulated consumers are taken into account
- Previously switched-in consumers are not taken into account, the actually measured value P L123 is evaluated

Connection:

- If the infeed increases / the delivery falls under the limit ON value set for the load / consumer on K1, the set delay ON time starts; if the limit value remains undercut for the entire time, the consumer on K1 is switched on and the set minimum start-up time begins
- If the infeed increases / the delivery continues to fall so that the consumer on K2 could also be switched on, after the expiration of the set delay ON time it is also switched on
- If the infeed increases / the delivery continues to fall so that the consumer on K3 could also be switched on, after the expiration of the set delay ON time it is also switched on

Disconnection:

- If the infeed decreases / the delivery increases over the limit OFF value set for the load / consumer, the set delay OFF time starts; if the limit value remains exceeded for the entire time, the consumer is switched off after the expiration of the minimum start-up time
- All consumers are switched off the same way
- Shut-down does not take place in a fixed sequence

Example:

- Analogue output: Phase angle control with heating element;
  K1: Heating element for service water heating; K2 Air-conditioner; K3: Heat pump,
  K1 has priority before K2, K2 has priority before K3

7.9 Program 5 (Pav,e and zero export / import added together, prevent/ limit infeed)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- Regulatory requirements from the grid-provider for limitation or prevention of energy flow accumulated over all 3 phases.

Goals:

- Prevent grid-infeed of mixed- or non-self-generated energy.
- Charging of batteries only in case of excess power and discharge during delivery only.
- Prevent or limit feed in of energy
- If necessary, switch on consumers before generating unit has to be limited or shut down.

Measurement:

- The EFR4000IP monitors the accumulated flow of energy at the grid connection point (purchase or delivery to the public power grid)
- The EFR4000IP monitors the flow of energy directly at batteries. (Prevent energy flow in inadmissible direction)

Feature:

- Measuring of actual power P L123 at point of measurement.
- The monitoring function is determined separately for each alarm/relay via the set limit values
  MAX monitoring: Power Kx off > Power Kx on;
  MIN monitoring: Power Kx off < Power Kx on;
- Fixed function of relay: alarm = relay off = contact x1-x4 open, contact x1-x2 closed.
- Storage of shut down (autoreset on = switched off), reset at device or disconnect Us.
- The three relay outputs (alarms) are working independently.
- Delay-OFF times can be set from 0 s (= reaction time <500 ms.)

Switch-off MAX monitoring:

- If power P L123 rises above the limit Kx off, delay off time starts. If power stays above limit for this time, Kx switches off.
- Reconnection: If power P L123 falls under the limit Kx on, the set delay on time starts. If the limit value remains undercut for the entire time, Kx switch on (after reset only when Autoreset = off).

Switch-off MIN monitoring:

- If power P L123 drops below the limit Kx off, delay off time starts. If power stays below limit for this time, Kx switches off.
- Reconnection: If power P L123 rises above the limit Kx on, the set delay on time starts. If the limit value remains exceeded for the entire time, Kx switch on (after reset only when Autoreset = off).

Examples:

- Pav,e - monitoring:
  see application description Pav,e
- Limitation of grid-infeed:
  Own-generating unit produces more power than permissible at the grid-connection point:
  EFR4000IP switches on 1 or 2 consumers. If this is not sufficient generation is reduced or switched off.
- Zero-grid-infeed: It is not allowed to feed into the grid.
  EFR4000IP switches on 1 or 2 consumers. If this is not sufficient generation is reduced or switched off.
- Storage without import:
  EFR4000IP shut down the unit, in case of power flow in inadmissible direction (to battery).
- Storage without delivery to grid (zero export):
  EFR4000IP shut down the unit, in case of power flow in inadmissible direction (to grid).
- Connection of adjustable consumer at the analogue output:
  The EFR4000IP regulates energy flow to a programmable value. Shut down only when power of consumer reaches maximum and energy flow cannot be limited sufficiently.

7.10 Program 6 (zero export / import device phase-wise, prevent/ limit infeed)

Precondition:

- Own generating unit, e.g. photovoltaic, CHP, wind rotor, water turbine, …
- Regulatory requirements from the grid-provider for limitation or prevention of energy flow in **one of the three phases**.

Goals:

- Prevent grid-infeed of mixed- or non-self-generated energy.
- Charging of batteries only in case of excess power and discharge during delivery only.
- Prevent or limit feed in of energy
- Limit feed in to maximum permissible value
- If necessary switch on consumers before generating unit has to be limited or shut down.

Measurement:

- The monitored phase can be selected independently for each alarm/relay. In setting L123 it is monitored if limit is reached in at least one phase (OR).
- The EFR4000IP monitors the flow of energy at the grid connection point (purchase or delivery to the public power grid)
- The EFR4000IP monitors the flow of energy directly at batteries. (Prevent energy flow in inadmissible direction)

Feature:

- Measuring of actual power P L1 or L2 or L3 or L123 as assigned to the alarms/relays.
- The monitoring function is determined separately for each alarm/relay via the set limit values
  MAX monitoring: Power Kx off > Power Kx on;
  MIN monitoring: Power Kx off < Power Kx on;
- Fixed function of relay: alarm = relay off = contact x1-x4 open, contact x1-x2 closed.
- Storage of shut down (autoreset on = switched off), reset at device or disconnect Us.
- The three relay outputs (alarms) are working independently.
- Delay-OFF times can be set from 0 s (= reaction time <500 ms.)

Switch-off MAX monitoring:

- If power in assigned phase rises above the limit Kx off, delay off time starts. If power stays above limit for this time, Kx switches off.
- Reconnection: If power in assigned phase falls under the limit Kx on, the set delay on time starts. If the limit value remains undercut for the entire time, Kx switch on (after reset only when Autoreset = off).

Switch-off MIN monitoring:

- If power in assigned phase drops below the limit Kx off, delay off time starts. If power stays below limit for this time, Kx switches off.
- Reconnection: If power in assigned phase rises above the limit Kx on, the set delay on time starts. If the limit value remains exceeded for the entire time, Kx switch on (after reset only when Autoreset = off).

Examples:

- Limitation of grid-infeed:
  Own-generating unit produces more power than permissible at the grid-connection point:
  EFR4000IP switches on 1 or 2 consumers. If this is not sufficient generation is reduced or switched off.
- Zero-grid-infeed: It is not allowed to feed into the grid.
  EFR4000IP switches on 1 or 2 consumers. If this is not sufficient generation is reduced or switched off.
- Storage without import:
  EFR4000IP shut down the unit, in case of power flow in inadmissible direction (to battery).
- Storage without delivery to grid (zero export):
  EFR4000IP shut down the unit, in case of power flow in inadmissible direction (to grid).

7.11 Analogue outputs function

The 0/4 … 20 mA current output can be optionally used as either an instrument transformer for power or as a control output.
A single phase or even the sum of all phases (added up together) is evaluated/controlled.

The 0/2 … 10V voltage output can be optionally used as either an instrument transformer for power or as a control output.
A single phase or even the sum of all phases (added up together) is evaluated/controlled.

Function	Single phase	Sum of all phase
Instrumental transformer	kW-L1 / kW-L2 / kW-L3	kW-L123
Load regulation	Load-L1 / load-L2 / load-L3	Load-L123

Requirements placed on the controller:
- The control must be linear since the regulated power is used to calculate the switching points
- The control must be made with phase control or trailing-edge control
  (wave packet control and multicycle control are not supported)

The configured set point value, e.g. +0.1 kW = 100 watts delivery is regulated
If consumers are connected to Relays K1…3, the power triggered by the controller is taken into consideration when switching in the relay. Consumers are switched on as soon as there is adequate power. At the same time, switch-on and switch-off points and times programmed for the relays are taken into account.
If the device detects a failure of the load controlled with the analogue output (deviation from the setpoint > control tolerance), the triggered power is not taken into account when switching in K1…3.

Example:
Load connected to controller = 1 kW (at 20 mA / 10V)
Controller set point = 0 kW (no delivery and no infeed)
Power connected to Relay K1 = 0.5 kW
Switch-on point K1 = -0.1 kW (= infeed 100 Watts)
The load on K1 is switched on as soon as the power controlled by the controller is so high (-0,6kW) that the switch-on point or K1 (-0,1kW) is reached after switching on the load (0.5kW).
This is the case with 0,6kW of regulated power (= 60% of the 1kW = 12mA / 6V at the output). The controller then tries to regain the setpoint under the new load conditions. This is also applying to the relay K2 and K3.
As soon as the set switch-off point is reached, the load on K1 is switched off.

7.12 Function of the digital inputs PR1…4

The EFR4000IP has 4 digital inputs for potential-free normally open contacts. That permits selectively switching each output relay on or off at any time. Consumers can therefore be blocked or switched on with external control. Y4 overwrites Y3, Y3 overwrites Y2, Y2 overwrites Y1.

Function examples:
- Heating element, shut-down by an external thermostat when the temperature is reached
- Heat pump, off periods through timer
- Priority control, washing machine remains on until it is finished
- Charge E-auto at fixed time
- Generate hot water on demand

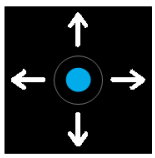
In addition, the analog outputs, when used as a control output, can be switched to 100% or 0%.

7.13 Function of the digital inputs PR5…6

If one of the output relays K1 … K3 Auto Reset > off is set, the respective relay remains switching off after a shutdown until a manual reset is carried out. In programs 5 and 6, the digital inputs Y1 … Y4 have the function of an external reset. A locked release can thus be deleted externally (button or switch). The function is equated with a reset by the device button. If one of the digital inputs Y1 … Y4 remains permanently closed, a locked trip will be deleted immediately, so the device automatically switches on again.

8 Commissioning

8.1 Information on operating



→	confirm, move / scroll right	↑	Increase value, move / scroll up, Min/Max value, 2s Reset
←	back, move / scroll left	↓	Decrease value, move / scroll down, 2s Menu

8.2 Switch on the unit / Language selection

During the initial start the unit displays the language selection. Once the language has been selected monitoring starts. The language can be changed at any time in the menu (Options -> language).

8.3 Device in the network

If the EFR4000IP is connected to a network via ethernet, the measured value displayed and parameterization can be performed via web browser on the computer. Basic knowledge of network technology is required for the configuration.

8.3.1 Find the device in the network

Network with DHCP server:

After connecting to the network, the device automatically receives an IP address.
Query IP address on the device:

- In menu mode, select the menu item “Network”
- Settings for the network parameters DHCP, IP address and subnet mask can be viewed and changed.

Set network with DHCP server / manual IP address:

The relevant network parameters can be set and changed directly on the device:

- In menu mode, select the menu item “Network”
- Make settings for the network parameters DHCP, IP address and subnet mask.

Connection:

start web browser on computer and enter the IP address in the address bar.

8.3.2 Call via web browser

After calling the IP address, the device logs in the web browser. For description, see **13 Webserver**.

8.4 Program selection

The suitable program must be set on the EFR4000IP in accordance with the application.
Setting procedure: Program&Code -> Program No

Pr	Description (switching sequence)	Analysis	Ethernet	Analogue output 0/4 … 20mA 0/2 … 10V
1	Max 1 Load / Consumer ON (the largest of up to 3 consumers is switched on)	Accumulative power L123 + Total connected loads/consumers + Analogue controlled Load	Modbus / Web-oberfläche	Control: Load L1 / L2 / L3 / L123 (3-phase) or Instrument transformer: kW-L1 / L2 / L3 / L123 (added-up)
2	Max 3 loads/consumers ON (largest load combination of 3-stages)			
3	3 loads (otherwise Pr2) /consumers ON (largest load combination of 7-stages)			
4*	3 loads/consumers ON (K1-K2-K3 are switched on in a fixed sequence), SG ready			
5	Pav,e – monitoring and Energy flow direction relay (zero export / import device) max 3 limit values (e.g. 2xadvance warning, 1 x shut-down)	Accumulative power L123		
6**	Energy flow direction relay (zero export / import device) max 3 limit values, separated by phase or all 3 phases simultaneously	Power L1 / L2 / L3 or L123 (=1 of 3)		

*** Factory set** **** Standard zero export / import device (L123)**

Tip:
When a program is changed, all parameters are reset to “factory setting” of the selected program (see table “Factory settings”). The network settings are retained after a program change.
Do not change the parameters until you have selected the correct program.

8.5 Description of the parameters

Menu	Parameters	Explanation	Adjustment range
Current transformer	Primary	Primary current of the current-transformer	1…1000 A
	Secondary	Secondary current of the current-transformer	1.0...5.0A
Relay	Power on K1/2/3	Max power consumption of the connected load, depending on the program the activated loads are offset against the measured value, After connecting a load the appropriate phase has to be changed by this amount (for 3-phase load by 1/3 each)	0.1…500.00 kW
	Phase K1/2/3	Phase(s) from which the load is supplied, after connecting a load, the value has to be changed on the related phase Pr6: Phase which is being evaluated, L123 all 3 phases are evaluated	L1 / L2 / L3 / L123
	Load ON K1/2/3	In which relay setting the load is switched on (Pr 5+6 11-12 = Alarm)	11-14 / 11-12
	Auto reset K1/2/3 (Pr5+6)	On: Relay switches back automatically Off: Relay only switches back after a manual reset (Y0-Y1 >100ms or close or press 2s button ↑)	on / off
Times	Delay on K1/2/3	The connect condition must be met uninterrupted for this time before it is switched on (Pr5+6 reconnection time)	10s…23h59m59s
	Min on K1/2/3	If a load is switched on, independent of the measured value it remains switched on until the expiration of this time is activated (minimum runtime)	10s…23h59m59s
	Delay off K1/2/3	The disconnect condition must be met uninterrupted for this time before it is switched off (Pr5+6 tripping time)	10s…23h59m59s (Pr5+6: 0s…59m59,99s)
	Load change K1/2/3	The period begins with the connection of a load, within this time a load change has to occur on the respective phase; otherwise a warning appears	10s…23h59m59s
Limits	power K1/2/3 on	Pr1…4: If the measured value (+ Total switched on consumers) falls below this value then the delay ON time starts	-999.99…999.99 kW
	power K1/2/3 off	If the measured value rises over this value and the minimum switch-on time has expired, the delay OFF time starts	-999.99…999.99 kW
	Pr5+6: Power Kx off > Power Kx on = MAX monitoring (exceed) Power Kx off < Power Kx on = MIN monitoring (undercut)		
	Shut-down value (Pr3)	Reset point; if the measured value rises above this value, one stage is switched back	-999.99…999.99 kW
Digital inputs	Y0-Y1	When digital input Y1 is closed, each relay can be individually being switched on / off or all relays on / off	K1 on / K1 off / K2 on / K2 off / K3 on / K3 off / K1-3 on / K1-3 off / Aout I 100% / Aout I 0% / Aout U 100% / Aout U 0%
	Y0-Y2, Y2 overwrites Y1	When digital input Y2 is closed, each relay can be individually being switched on / off or all relays on / off	
	Y0-Y3, Y3 overwrites Y2	When digital input Y3 is closed, each relay can be individually being switched on / off or all relays on / off	
	Y0-Y4, Y4 overwrites Y3	When digital input Y4 is closed, each relay can be individually being switched on / off or all relays on / off	

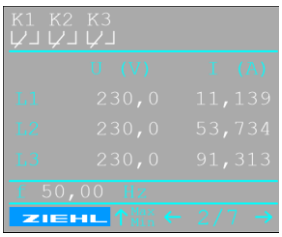
Menu	Parameters	Explanation	Adjustment range
Analogue output U	Function	Analogue output as an instrument transformer (kW-Lx) or as a control output (Load-Lx) for, e.g., linear phase angle control	off / kW-L123 / kW-L1 / kW-L2 / kW-L3 / Load-L123 / Load-L1 / Load-L2 / Load-L3
	Mode	0 or 2 V … 10 V	0…10 V / 2-10 V / ind. ZP
	Zero point (instrument transformer)	Power in kW for zero point, Power in kW for full-scale **-**: Feed in (excess) **+**: Delivery (Zero point and full-scale may also have different signs)	-999,99…999,99 kW
	Full-scale (instrument transformer)		-999,99…999,99 kW
	Individual zero point	Individual zero point, this is the smallest value which is controlled on the analogue output	0 … 5 V
	Set point (Load / Control)	With sufficient load regulates the analogue output to this value	-999,99…999,99 kW
	Max. power (Load / Control)	Max. power consumption of the controlled load at 10 V	0,1…500,00 kW
	Control speed	Slow (20%)…fast (90%), Control response = (difference between the set point-actual value) * 20…90%	20…90 %
	Control interval	The set point value is readjusted in this interval; fast (0.5s) … slow (60.0s)	00,5…60,0 s
	Control tolerance	Difference set point actual > Control tolerance = Failure of the load is detected, e.g. due to a thermostat being switch-off; load on the analogue output is not taken into account by K1-3 when additional loads are switched on	5…50 %
Analogue output I	Function	Analogue output as an instrument transformer (kW-Lx) or as a control output (Load-Lx) for, e.g., linear phase angle control	off / kW-L123 / kW-L1 / kW-L2 / kW-L3 / Load-L123 / Load-L1 / Load-L2 / Load-L3
	Mode	0 or 4 mA … 20 mA	0…20 mA / 4-20 mA / ind. ZP
	Zero point (instrument transformer)	Power in kW for zero point, Power in kW for full-scale **-**: Feed in (excess) **+**: Delivery (Zero point and full-scale may also have different signs)	-999,99…999,99 kW
	Full-scale (instrument transformer)		-999,99…999,99 kW
	Individual zero point	Individual zero point, this is the smallest value which is controlled on the analogue output	0 … 10 mA
	Set point (Load / Control)	With sufficient load regulates the analogue output to this value	-999,99…999,99 kW
	Max. power (Load / Control)	Max. power consumption of the controlled load at 20mA	0,1…500,00 kW
	Control speed	Slow (20%)…fast (90%), Control response = (difference between the set point-actual value) * 20…90%	20…90 %
	Control interval	The set point value is readjusted in this interval; fast (0,5s) … slow (60,0s)	00,5…60,0 s

Menu	Parameters	Explanation	Adjustment range
Analogue output I	Control tolerance	Difference set point actual > Control tolerance = Failure of the load is detected, e.g. due to a thermostat being switch-off; load on the analogue output is not taken into account by K1-3 when additional loads are switched on	5…50 %
Program & Code	Program no.	Setting the program	1…3
	Default settings	Set the parameter to factory settings	yes / no
	Code lock	Switch code lock on/off, Factory Preset code 504, for details please refer to 8.7 Code lock / Code reset	0…9999
Network	DHCP	Allows automatic assignment of an IP address from the network	On / off
	IP address	Setting a fixed IP address	000.000.000.000/ 255.255.255.255
	Subnet mask	Configure the subnet mask	000.000.000.000/ 255.255.255.255
Options	Language	Selects the language	German / English
	Brightness	The brightness to which the display is dimmed after the expiry of the dimming time	20…99 %
	Dimming time	Starts with the last press of a button; after expiration of the time the display is dimmed to the set brightness value	10s…01h00m00s
	Num. interval	Time interval in which the measured values are updated (to smooth the display)	00.1…02.0 s
Simulation	Relay	Simulate relay (On / Off)	
	Function	Complete functional simulation, analogue output and digital inputs	
Info	Firmware version	Display of the firmware version	0-00
	Serial number	Display of the serial number	0…999999
	Operating hours	Display of the operating hours (zero voltage retentive)	h
	Display error counter	Displays the number of errors that occurred (zero voltage retentive)	Err 1…9
	Clear error counter	Clears the error counter	Delete
	Display switch-on time	Displays the total switch-on time of the relay (is also indicated on display page 3.)	0…99999 min
	Clear switch-on time	Clears the entire switch-on time of the relay	Delete
	Warnings	Current pending warnings with help text	
	Comments	When parameterizing via the web interface, a comment with max. 208 characters can be stored and is displayed here	

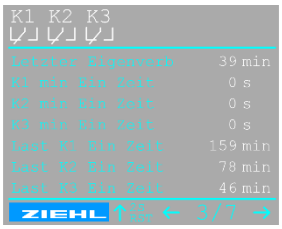
* Possibility to store settings e.g. summer / winter

8.6 Description of the display pages (measured values)

1 / 7	
P L123	Power added together (sum of the 3 phases) in kW
P L1	Power L1 in kW
P L2	Power L2 in kW
P L3	Power L3 in kW

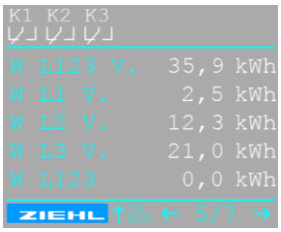


2 / 7	
U L1	Voltage L1 in V
U L1	Voltage L2 in V
U L2	Voltage L3 in V
I L1	Current L1 in A
I L2	Current L2 in A
I L3	Current L3 in A



3 / 7	
last own consume	Time without internal consumption (via EFR4000IP)
K1…3 Min ON time	Counts down the minimum switch-on time
K1…3 delay ON time	Counts down the delay ON time
K1…3 delay OFF time	Counts down the delay OFF time
Load K1…3 ON time	Total switch-on time of the load on relay K1…3 (zero voltage retentive)

4 / 7	
Firmware	Firmware version
Program No.	Current program
Digital inputs	Current state of the digital inputs
Analog output U+I	Actual value at the analogue output
Code lock	Current state of the code lock
IP address	Actual IP address
Warnings	Current pending alarms (device still works, but maybe not optimally)



5 / 7	
W L123 V.	Energy meter Total consumption in kWh
W L1 V.	Energy meter L1 consumption in kWh
W L2 V.	Energy meter L2 consumption in kWh
W L3 V.	Energy meter L3 consumption in kWh
W L123	Energy meter Total consumption + reference in kWh

6 / 7	
W L123 B.	Energy meter Total reference in kWh
W L1 B.	Energy meter L1 reference in kWh
W L2 B.	Energy meter L2 reference in kWh
W L3 B.	Energy meter L3 reference in kWh
W L123	Energy meter Total consumption + reference in kWh

7 / 7	
W K1	Energy meter Total K1 in kWh (extrapolation)
W K2	Energy meter Total K2 in kWh (extrapolation)
W K3	Energy meter Total K3 in kWh (extrapolation)
W Aout U	Energy meter Aout U in kWh (extrapolation)
W Aout I	Energy meter Aout I in kWh (extrapolation)
W Aout I	Energy meter Total in kWh (extrapolation)

Info:
Depending on the program, the order of display pages may also vary. In addition, display pages may be hidden and thus deviate from the total number.

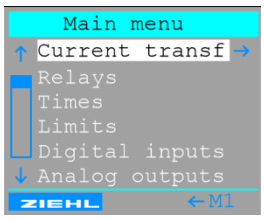
8.6.1 Explanation of the symbols

= Apply and save value / setting

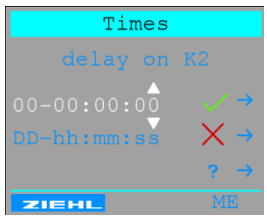
= Back, value / parameter will not be saved

= Help text on the value / parameter

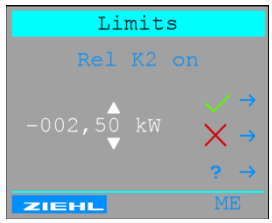
8.6.2 Display Examples



Display Menu



Display Time Setting



Display Limit value setting

8.7 Code lock / Code reset

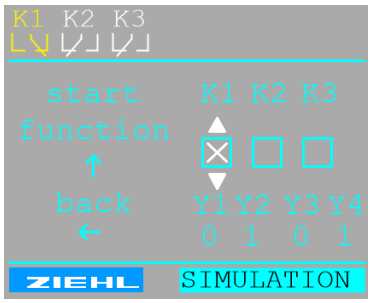
Program & Code -> code lock

You can protect all parameters by enabling the code lock. The factory setting is Code 504.
In the event of problems with the code lock (forgot the code) the lock can be switched off and the code reset to 504 when switching the power on by keeping the key pressed up (approx. 4s) until the message Code off is displayed.

8.8 Simulation

Simulation -> relays

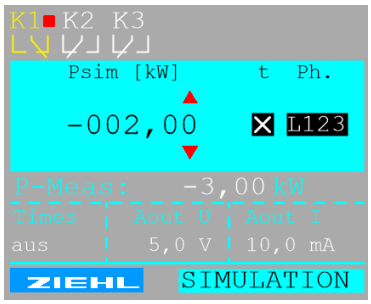
Here you can set the output relay, regardless of the measured ON or OFF value.
That will actually turn the connected loads / consumers on or off!
In addition, the current state of the digital inputs is displayed.



K1	☒ = Relay ON 11-14
K2	☒ = Relay ON 21-24
K3	☒ = Relay ON 31-34
Y1- Y4	Actual state of the digital inputs, 0 = open, 1 = closed

Simulation -> function

In the simulation function a measurement value can be simulated even without connecting measuring inputs. All functions of the device operate as if this value is actually being measured. Matching with the simulated measured value, the value at the analogue output (not when control is active) is also output.



Psim [kW]	Simulated measures value
t	☒ = active time ☐ = fixed time 1s
Ph	Phase being simulated
P-Meas	Measured value for evaluation (simulated value + switched on load / consumers)
Times	Time state
Aout U + I	Value at the analogue output

The set value is simulated until the simulation is excited by pressing the ← or → button several times. If no key is pressed for 15 minutes the simulation is also exited.

9 Troubleshooting and corrective measures

Error messages appear in the display footer displayed in red. (Err) As soon as a fault is resolved this message disappears automatically. I.e. error messages do not have to be acknowledged. If the key ➔ is pressed in Display page 4, a help text appears for each pending fault.

Errors 1-9 can be detected by the EFR4000IP itself, the numbering is used in the fault memory (only in the display) and in the logging:

No	Fault	Cause	Corrective measure
1	Limit error	Limit ON must be less than limit OFF	Exchange limits
2	Limit difference error	Difference between limit value ON and limit value OFF is less than the set value. Output relay would switch between on and off.	Adjust limits or load value
3	AD converter error	Internal AD converter error	Reset, interrupt supply voltage Us for > 5s*
4	Adjustment values error	Adjustment values are out of tolerance.	
5	Parameter error	Parameter value out of range.	
6	Internal memory error	Error in internal memory	
7	Current transformer error	Current transformer connections reversed, current transformer incorrectly connected.	**+**: reference **-**: infeed, turn current transformer, Replace S1(k) and S2(l) on the EFR4000IP (switch off primary circuit first!)
8	Vault load value (only in Pr 3)	At least 2 relays have the same load value.	In Pr3, there must be no 2 equal loads, if necessary, slightly increase a load value.
9	Setting error regulation	Analogue outputs U and I cannot control to the same measured value / phase.	Deactivate a regulation or regulate it to another phase.

Other errors are:

Fault	Cause	Corrective measure
Sign is not correct	Current transformer connected the wrong way around	**+**: reference **-** : infeed, rotate current transformer, Exchange S1(k) and S2(L) on the EFR4000IP (switch off primary circuit first!)
Measured value changes when connecting a load in the wrong direction	Check the current transformer	
Device function is not plausible	False configuration	Get warnings (Info -> warnings); the EFR4000IP recognizes any incorrect settings / functions and displays suggested solutions
Implausible measured values	Neutral conductor not connected	Connect the neutral conductor
The display is blank	Supply voltage not connected	Connect supply voltage in accordance with the page type plate at terminals A1 and A2

-EEE or EEE appears in the display	Measurement is above/below range	Measured voltage is too small or too large; comply with measurement range
Screen too dark	The display is dimmed after the set time (Options -> dimming time); the brightness is set too low (Options -> dimming time)	Increase brightness (Options -> brightness)
The device cannot be configured	Code lock activated	In the event of problems with the code lock (forgot the code) the lock can be switched off and the code reset to 504 when switching the power on by keeping the key pressed upward (approx. 4s) until the message Code Off appears.
No access via Ethernet	DHCP is active, but no IP address has been assigned	Check DHCP server or assign fixed IP address
	Invalid network area	Check the address range of the IP address and the subnet mask

* Send the device to the factory for repair if the error has not been cleared after a reset.

10 Tips and Tricks

Short periods of time (delay on/off, minimum switch-on time) allow the EFR3000 a faster response to changes and better optimization.
Attention: Some consumers have limited switching frequencies or processes (washing machine) and must not be interrupted.

11 Technical data

Supply voltage Us (A1, A2)	DC/AC 24 … 240 V 0/50/60 Hz		
Tolerance	DC 20,4 … 297 V	AC 20 - 264 V	
power consumption	< 3 W	< 9 VA	
Output relay K1, K2, K3	3 x 1 change over contact		
Switching voltage	max. AC 300 V;	DC 300 V	
Inrush current normally open (NO)	AC 25A 4s / 50A 1s 10% ED		
min. voltage / current	12 V 10 mA		
conventional thermal current Ith	max. 9 A		
Switching power max. AC cos φ = 1	2000 VA		
Switching power max. DC (ohm)	0,3 A 300 V / 0,4 A 120 V / 0,8 A 60 V / 16 A 28 V		
Contact service life, electr. cos φ = 1	10^5 operating cycles 300 V / 9 A		
Short circuit strength (NO, NC)	Circuit-breaker B10 or 10A L / gG Neozed		
Rated short-circuit current	1000A, cos φ = 0,5 bis 0,7		
Short circuit strength (NC)	3,15A suggish		
Rated operational current	AC-15	Ie = 6 A	Ue = 250 V
	DC-13	Ie = 2 A	Ue = 24 V
	DC-13	Ie = 0,2 A	Ue = 250 V
Test conditions	EN 61010-1		
Rated impulse withstand voltage	4000 V		
Overvoltage category	III		
Pollution degree	2		
Rated insulation Ui	300 V		
Operating time	100 %		

Wiring connection

Supply voltage	(Us)	A1, A1', A2
Measuring inputs	(Meas)	1I1(k), 1I2(l), 2I1(k), 2I2(l), 3I1(k), 3I2(l), L1, L2, L3, N
Digital inputs	(Dig)	Y0, Y1, Y2, Y3, Y4
Interface	(Ethernet)	RJ45
Analog Output	(Analog)	GND (⏚), I+, U+
Relay	(Rel)	K1: 11, 12, 14 / K2: 21, 22, 24 / K3: 31, 32, 34
Isolation / Test voltage		Us → Mess, Dig, IP, Analog, Rel DC 3820 V
		Mess → Dig, IP, Analog, Rel DC 3820 V
		Rel → Dig, IP, Analog DC 3820 V
		Rel (K1) → Rel (K2) → Rel (K3) DC 3820 V

Installation conditions		
Operating temperature	-20 °C ... +55 °C	
Storage temperature	-20 °C …+70 °C	
Altitude	< 2000 m above sea level	
Climate resistance	5-85% rel. humidity, no condensation	
Wiring temperature	-5 °C …+70 °C	
Vibration resistance EN 60068-2-6	2 … 13,2 Hz ±1 mm	13,2 ... 100 Hz 1 g
	2…25 Hz ±1,6 mm	25 ... 150 Hz 5 g

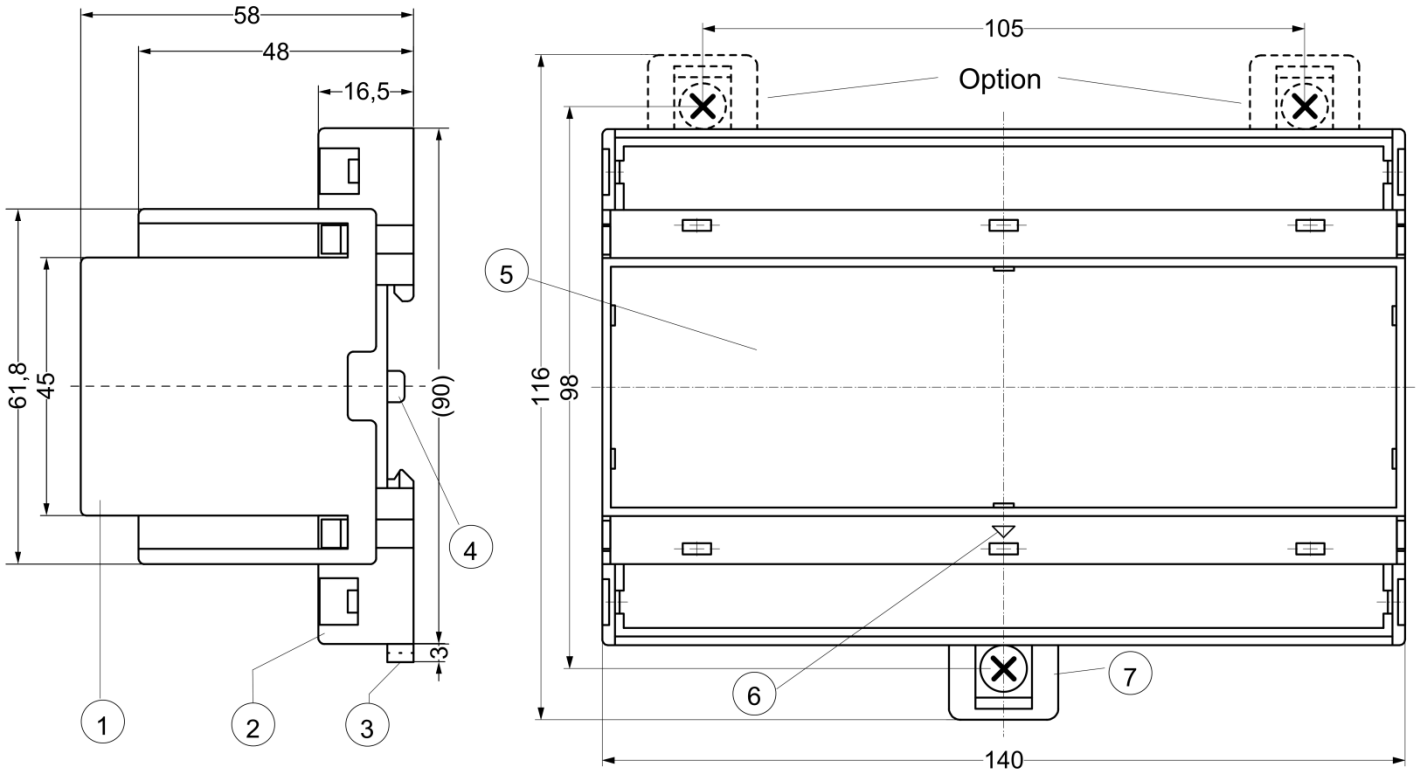
EMC-Tests	EN 61326-1	
EMC emission	EN 61326-1; CISPR 11 class B	
EMC immunity	EN 61326-1 industrial environment	
External Inputs	app. DC 18 V / 3,5 mA	
Digital Inputs Y0 - Y1 / Y2 / Y3 / Y4	function programmable	
Measurement of voltage (L1 / L2 / L3 towards N)		
Voltage (Phase – N)	AC 40,0 … 330,0 V, 45 … 65 Hz	
Measuring principle	True RMS	
Max. error of measurement	±0,5% of fullscale, ± 1 Digit	
Input resistance Phase – N	> 600 kΩ	
Power consumption Phase – N	max. 0,15 VA	
Measurement of current (1I1(k) – 1I2(l), 2I1(k) – 2I2(l), 3I1(k) – 3I2(l))		
Nominal current	AC 1 A / 5 A	45 … 65 Hz
Measuring range	AC 0,002 … 6,000 A	45 … 65 Hz
Resolution	1 mA	
Measuring principle	True RMS	
Max. error of measurement	±0,5% of fullscale, ± 1 Digit	
Overload capacity		
continuously	8 A	
max. 1 s	25 A	
Inputs resistance	ca. 25 mΩ	
Power consumption	ca. 0,25 VA (1 A)	0,63 VA (5 A)
Connection of current measurement only with external current transformers:		
External current transformer Primary	1 … 1000 A	
External current transformer Secondary	1,0 … 5,0 A	
Measurement of active power	Multiply values by factor of current transformers	
Range 1 A, per Phase / total	-300 … 300 W	/ -900 … 900 W
Range 5 A, per Phase / total	-3,96 … 3,96 kW	/ -9,99 … 9,99 kW
Range max., per Phase / total	-396 … 396 kW	/ -999 … 999 kW
Resolution	1 W	
Max. error of measurement	±1% of fullscale ± 1 Digit	
Reaction time zero export / import device	< 500ms + delay off	
Energy count (active power)		
Counting range	-2.147.483 kWh … 2.147.483 kWh	
Max. error of measurement	+- 5%	
Max. error relay / analogue outputs	Values are only extrapolations (as consumers can also be switched off externally)	

Analog output (GND (⊥), I+)	DC 0/4 …. 20 mA for active power ±999 kW, scalable
Max. error	±0,3 % of fullscale (ab 0,1 mA) + error of measurement active power
Temperature factor	< 0,015 % / K
Resolution	11,6 Bit < 6,1 µA
Load	≤ 500 Ω
error load	(250 Ω – load) / 250 Ω * 0,3 % of current
Regulation/ control	linear, phase control or phase alignment, with reinforced insulation / protective separation
Analog output (GND (⊥), U+)	DC 0/2 … 10 V for active power ±999 kW, scalable
Max. error	±0,3 % of fullscale (ab 0,1 V) + error of measurement active power
Temperature factor	< 0,01 % / K
Resolution	11,6 Bit < 3,1 V
Load	≥ 1 kΩ
error load	(250 Ω – load) / 250 Ω * 0,3 % of current
Regulation/ control	linear, phase control or phase alignment, with reinforced insulation / protective separation
Ethernet	Parameterization, measured values, firmware update, Modbus TCP, logging
Speed	10 / 100 Mbit/s
IP address	Adjustable / DHCP, default: DHCP on
Subnet mask	Adjustable , default: 255.255.255.255
Real Time Clock (RTC)	
Power reserve	>11 Days at 25 °C
Time deviation	±3 ppm
Housing	construction type V8, distribution board
Mounting depth	56 mm
Width	8 units
Dimensions (W x H x D)	140 x 90 x 58 mm
<u>Terminals for measuring inputs:</u>	
Wiring connection single strand	1 x 0,34 – 4,0 mm² / AWG 22 - 12
Finely stranded with wire end ferrule	1 x 0,34 – 2,5 mm² / AWG 22 - 12
<u>Other terminals:</u>	
Wiring connection single strand	1 x 0,34 - 2,5 mm² / AWG 22 - 12
Finely stranded with wire end ferrule	1 x 0,1 -1,5 mm² / AWG 27 - 14
Stripping length / specify torque	8 mm / 0,5 Nm
Protection class housing / terminals	IP 30 / IP20
Mounting	Snap-on fastening on 35 mm mounting rail acc. EN 60 715 or with M4 screwed attachment (additional bar not included in the scope of delivery)
Weight	app. 300 g

Subject to technical changes

12 Housing Type V8

Dimensions in mm

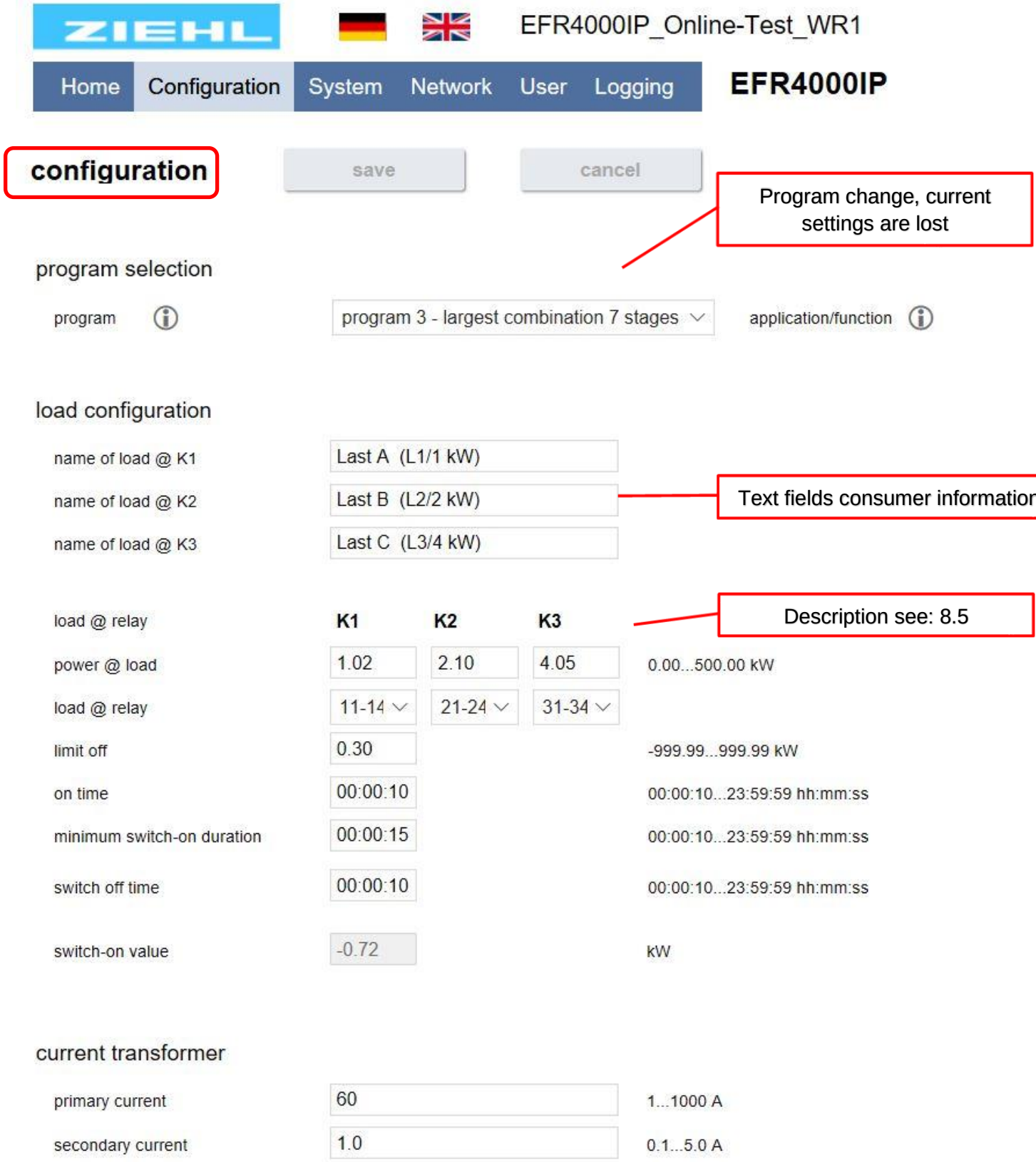


1	Oberteil / cover
2	Unterteil / base
3	Riegel / bar for snap mounting
4	Plombenlasche / latch for sealing
5	Frontplatteneinsatz / front panel
6	Kennzeichen für unten / position downward
7	Riegel bei Wandbefestigung mit Schrauben. Riegelbohrung Ø 4,2 mm / for fixing to wall with screws, Ø 4,2 mm

13 Webserver

Before changes are accepted, they must always be saved.

13.1 Configuration



configuration

save cancel

analog output U

Description see: 7.9

function	measurement conv. L123	
mode	0...10 V	
zero	0.00	-999.99...999.99 kW
full scale	-10.00	-999.99...999.99 kW
target value	100.00	-999.99...999.99 kW
maximum power	80.00	0.00...500.00 kW
regulation speed	90	20...90 %
regulation interval	0.5	0.5...60.0 s
regulation tolerance	50	5...50 %

analog output I

Description see: 7.11

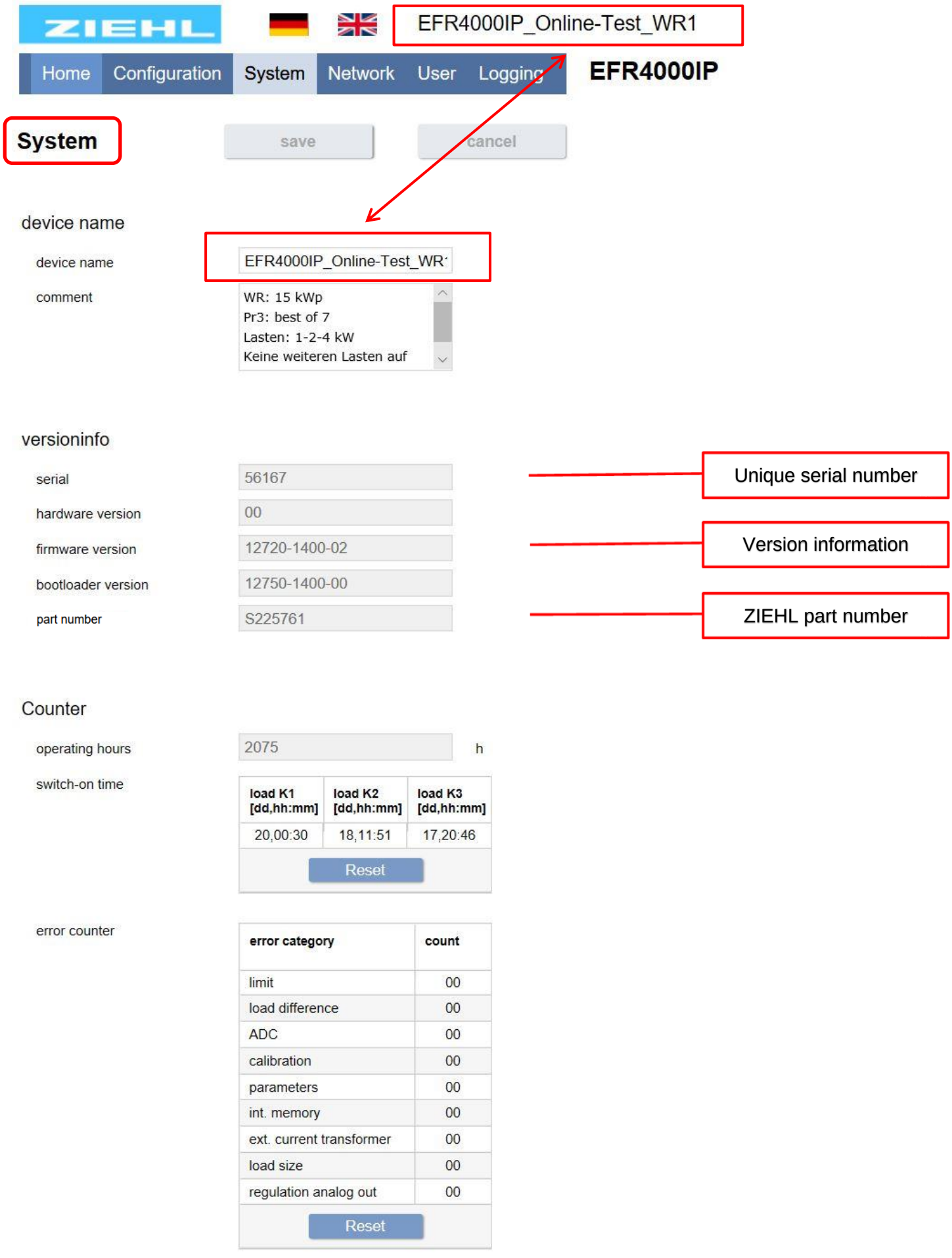
function	control output L123	
mode	0...20 mA	
zero	10.00	-999.99...999.99 kW
full scale	-10.00	-999.99...999.99 kW
target value	0.00	-999.99...999.99 kW
maximum power	2.00	0.00...500.00 kW
regulation speed	90	20...90 %
regulation interval	1.0	0.5...60.0 s
regulation tolerance	5	5...50 %

digital inputs

Description see: 7.12/7.13

digtal input Y0-Y1	off	lowest priority
digtal input Y0-Y2	off	:
digtal input Y0-Y3	off	:
digtal input Y0-Y4	off	top priority

13.2 System


ZIEHL
EFR4000IP_Online-Test_WR1
Home
Configuration
System
Network
User
Logging
EFR4000IP
System
save
cancel
device name
device name
EFR4000IP_Online-Test_WR
comment
WR: 15 kWp
Pr3: best of 7
Lasten: 1-2-4 kW
Keine weiteren Lasten auf
versioninfo
serial
56167
hardware version
00
firmware version
12720-1400-02
bootloader version
12750-1400-00
part number
S225761
Unique serial number
Version information
ZIEHL part number
Counter
operating hours
2075
h
switch-on time
load K1 [dd,hh:mm]
load K2 [dd,hh:mm]
load K3 [dd,hh:mm]
20,00:30
18,11:51
17,20:46
Reset
error counter
error category
count
limit 00
load difference 00
ADC 00
calibration 00
parameters 00
int. memory 00
ext. current transformer 00
load size 00
regulation analog out 00
Reset

System

save cancel

The measured values are updates in this interval (display only)

display settings (lcd display only)

dispaly language	deutsch	
display interval	0.5	0.1...2.0s
brightness	50	20...100%
time to dim	300	10...3600s

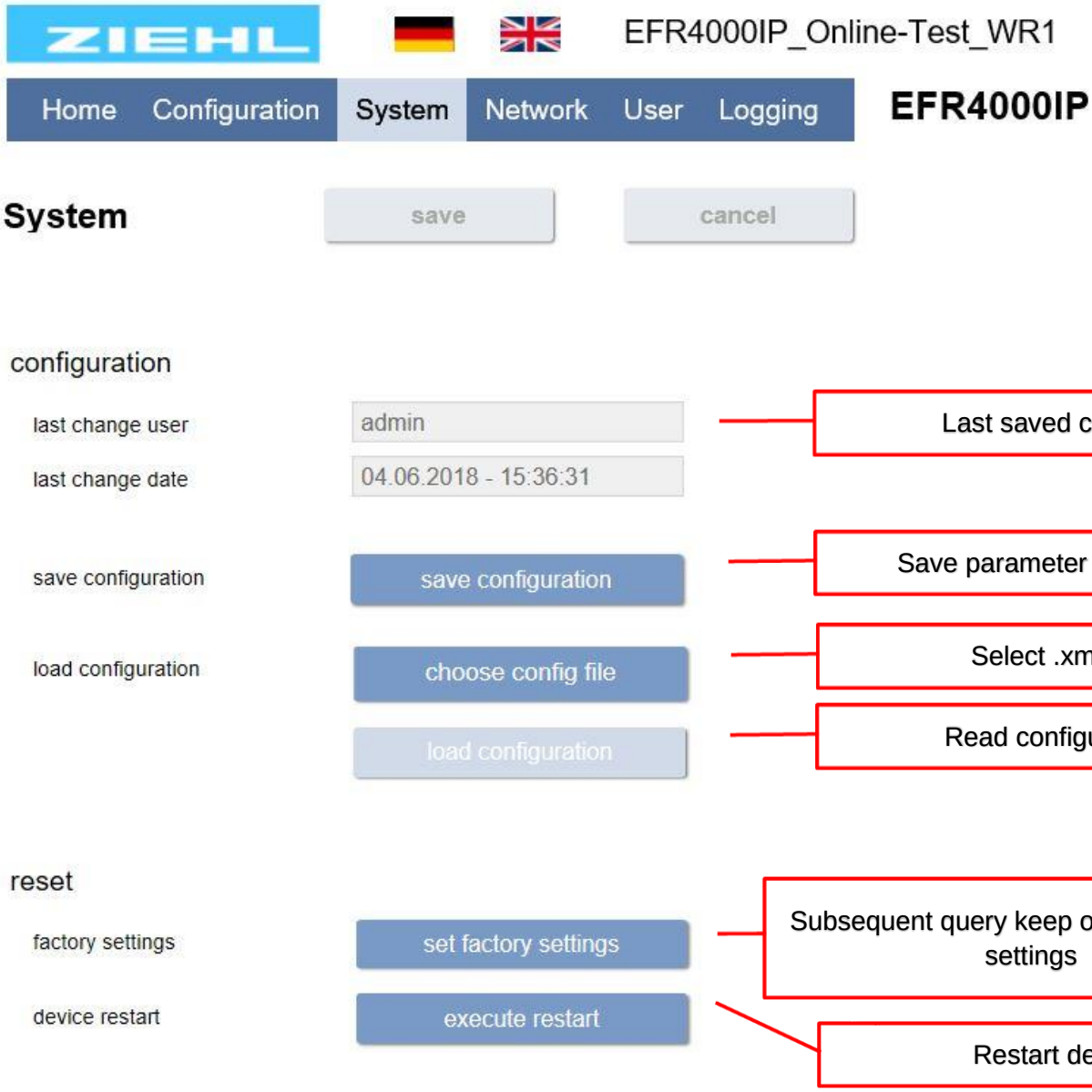
Display Code lock (pin code at delivery or after code reset 504)
reset the code by pressing the „Up“ button when switching on the power

pin lock settings (lcd display only)

pin lock	OFF	
change pincode		0...999999
verify pincode		0...999999

firmware update

update notification	enabled	Notification appers when calling the home page
searching for updates	check for updates...	Update to current version of ZIEHL server
update installation	choose firmware file	Update from a local location
	update installation	Start update
	cancel	


EFR4000IP_Online-Test_WR1
Home
Configuration
System
Network
User
Logging
EFR4000IP
System
save
cancel
configuration
last change user
admin
last change date
04.06.2018 - 15:36:31
Last saved change
save configuration
save configuration
Save parameter in .xml file
load configuration
choose config file
Select .xml file
load configuration
Read configuration
reset
factory settings
set factory settings
Subsequent query keep or reset network settings
device restart
execute restart
Restart device

13.3 Network

Network save cancel

network settings

host name	EFR4000IP
DHCP	OFF
IP-address	172.26.3.50
subnet mask	255.255.255.0
gateway	172.26.3.1
DNS server	172.26.3.1
Mac	00:12:e4:00:24:5d

Hostname Aa-Zz, 0-9 and -

Network parameters only if DHCP off

modbus settings

modbus TCP	ON Port 502

Modbus TCP interface, details see extra instructions

timeserver settings

current time	07.06.2018 - 13:50:34
timeserver	ON
name / IP-address	pool.ntp.org
last update	07.06.2018 - 13:42:52

Current time settings

new Date		DD.MM.JJJJ
new Time		hh:mm:ss
set date/time	set date/time	

Set time manual

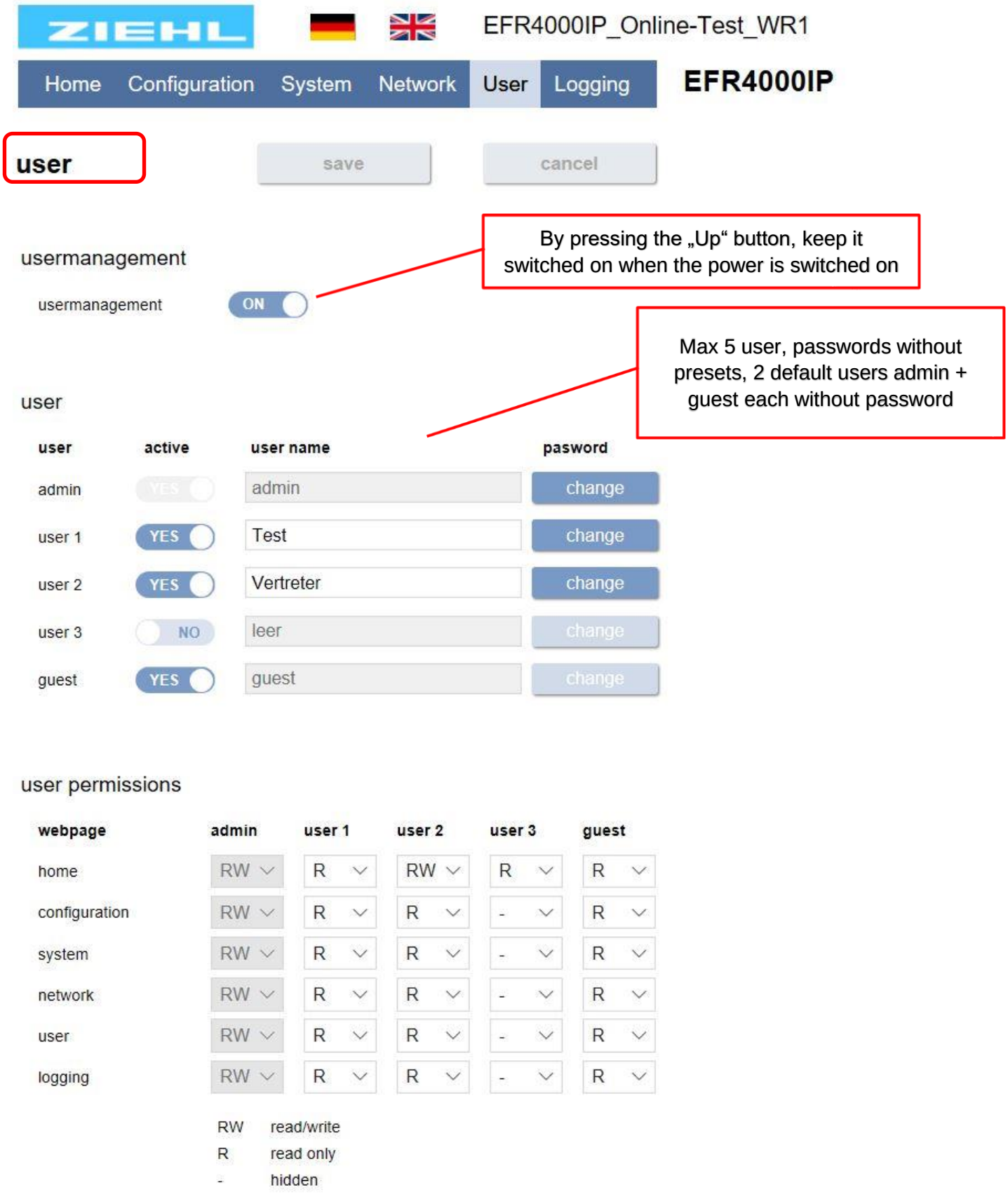
time zone settings

time zone	CET/CEST
UTC time offset	+01:00 hh:mm

	weekday	month	week	time	time dif.	
start of daylight saving time	Sunday	March	last week	02:00	+01:00	hh:mm
end of daylight saving time	Sunday	October	last week	03:00	-01:00	hh:mm

13.4 User (only on webserver)

The user control has no influence on the display and Modbus TCP.
In the event of problems with the user administration (password forgotten), this can be switched off by pressing the button upwards (app. 4s) when switching on the power supply until a selection menu appears → choose user administration.



Logout button in the footer (only appears with activated user management)

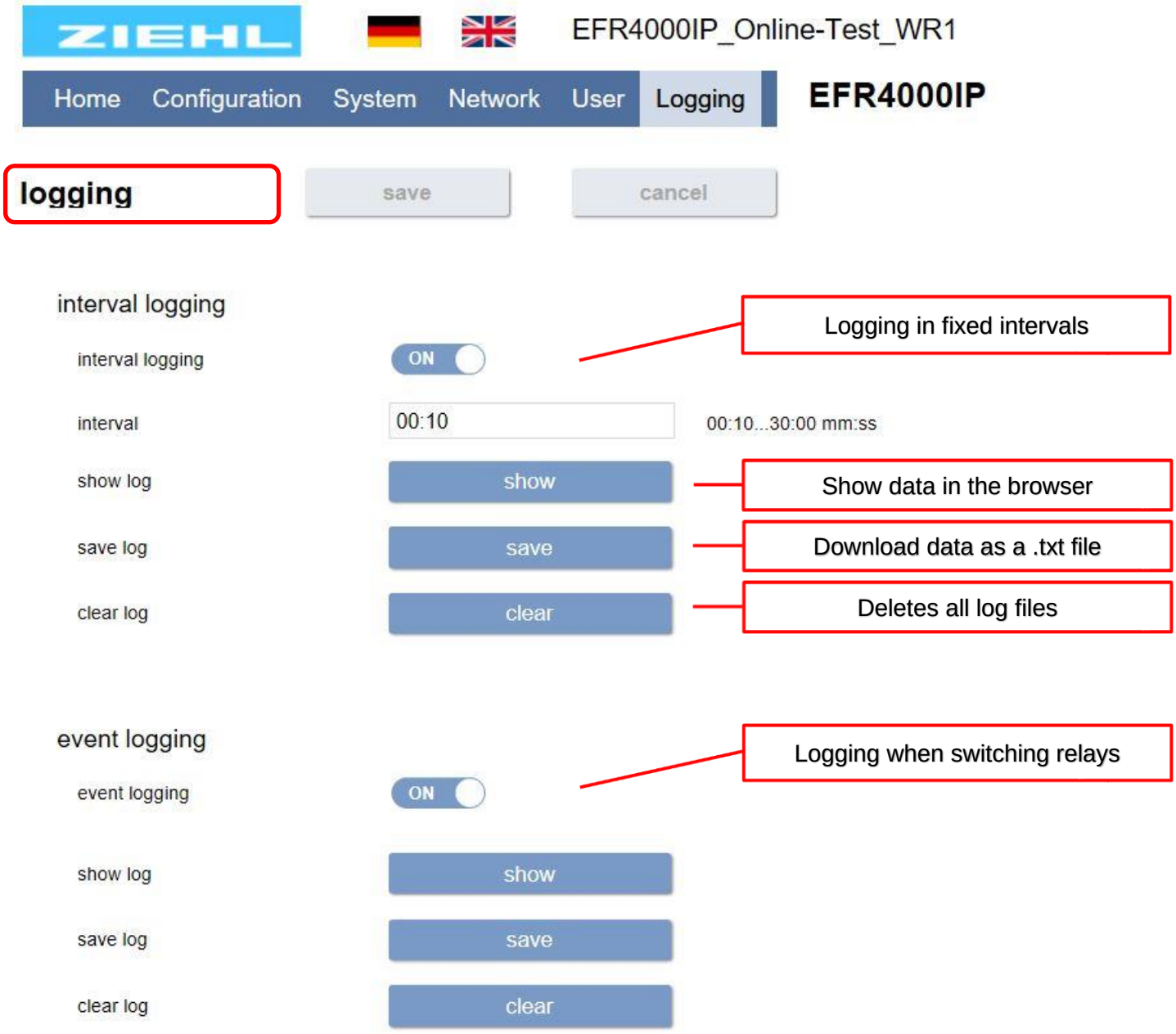
13.5 Logging

Interval Logging:
Ring memory for 1292 logs possible,
Max logging time depends on the interval 10s = 3:58h / 1min = 21:32h / 10min = 8d23h / 60min = 53d20h

Event Logging:
Ring memory for 243 logs possible, whenever min. 1 relay switches

The following data is logged:

- Time stamp UTC + Local by time zone
- Current power readings
- Energy meter
- Relay stat
- State of digital inputs
- Error Stat (Description see Troubleshooting and corrective measures)



13.6 Home

current values (feed-in = negative)

Measured values for switching function

phase	power	feed-in	draw	voltage	current
phase L1	**-3.330 kW**	-693.5 kWh	48.2 kWh	233.5 V	15.62 A
phase L2	**-2.293 kW**	-424.3 kWh	125.5 kWh	233.4 V	11.45 A
phase L3	**-0.447 kW**	-142.2 kWh	437.7 kWh	233.9 V	5.81 A
phases L123	**-6.070 kW**	-1260.0 kWh	611.4 kWh		

draw - feed-in -648.6 kWh reset feed-in/draw

last reset: 27.04.2018 - 10:19

Energy meter value individually+summed

load

State of consumers

name	state	active times [hh:mm:ss]	@ relay
Last A (L1/1 kW)	ON	-	K1
Last B (L2/2 kW)	ON	-	K2
Last C (L3/4 kW)	ON	-	K3

last own consumption 07.06.2018 - 13:52

analog outputs

State of analogue outputs

type	function	range	actual value	power
voltage U	measurement conv. L123	0...10 V	6.1 V	0.00 kW
current I	control output L123	0...20 mA	20.4 mA	0.00 kW

timer

Manual control of consumers, see : 13.7

load	function	duration [hh:mm]		load [%]	action
Last A (L1/1 kW)	on for	00:01	00:01...24:00	-	start
Last B (L2/2 kW)	auto		00:01...24:00	-	start
Last C (L3/4 kW)	auto		00:01...24:00	-	start
analog output U	auto		00:01...24:00	0	start
analog output I	auto		00:01...24:00	100	start

electricity meter (values calculated)

Energy meter consumers (calculated)

	Last A (L1/1 kW)	Last B (L2/2 kW)	Last C (L3/4 kW)	analog out U	analog out I
own consumption	382.7 kWh	729.3 kWh	1354.1 kWh	0.0 kWh	27.5 kWh
total	**2493.6 kWh**				

reset electricity meter

last reset: 26.04.2018 - 13:44

status

active program	03	
relay state K1,K2,K3	1 - 1 - 1	
digital input Y1	state: 0,	function: none
digital input Y2	state: 0,	function: none
digital input Y3	state: 0,	function: none
digital input Y4	state: 0,	function: none

General status display

warnings:

Load size K2 loads >= 2 kW must be connected via a couplingrelay

Load size K3 loads >= 2 kW must be connected via a couplingrelay

Warnings / information

errors:

no errors

Error messages

start simulation

Simulate measured value, see: 13.8

13.7 Timer function

timer

The timer function allows manual interventions, which bypass the normal switching function. (Priority)
Timer function are possible for all 3 output relays and for the analogue outputs with the load control function.
Activated Timer functions are signalled under consumer -> Condition

Function	Description	Start- / Stop command
auto	Normal switching function after set program is executed	Directly after selection, does not need to be started separately
manual on / off	Relay / Analog outputs remain permanently on and off	
On for	Relay: is switched on for the entered time Analog output: is switched on fort he entered time with the set power (% of maximum power)	Start / Stop Button
Off for	Relay: is switched off fort he entered time Analog output: switched off fort he entered time (with value for zero point activated)	

13.8 Simulation

In the function simulation, a measured value can be simulated even without connected measuring inputs. All function of the device work as if this value is actually measured. The value is also output to transducers analogue outputs in accordance with the simulated measured value.