## OptiSave allow to establish secure power supply of your facilities

- OptiSave L Automatic transfer unit of lighter functional characteristics
- OptiSave H Automatic transfer unit of extended functional characteristics



## OptiSave are automatic transfer switch units for power supply of facilities in emergency modes.



## Automatic transfer units of OptiSave series



The automatic transfer unit OptiSave features a control device designed to automatically switch to a spare line in the event of a malfunction or disconnection of the operating line. The device is designed to operate in assembly with control cabinets of automatic switch of power backup in the systems of secure and uninterruptible power supply of 3-phase power-consuming units of the I and II reliability categories in compliance with the requirements of the Electrical Installation Code.

## Designation




The references listed in the tables of the unit are subject to change. If the references you need are not found on the site, contact the technical support service of KEAZ.

## Selection guide

|  | OptiSave L-220 | OptiSave L-230 | OptiSave H-243 | OptiSave H-233-G |
| :---: | :---: | :---: | :---: | :---: |
| Appearance |  |  |  |  |
| Reference | 248974 | 248956 | 281763 | 285581 |
| Maximum load current, A (AC1 at a voltage of 250 V ) | 5 | 5 | 16 | 16 |
| Control of switching devices |  |  |  |  |
| Contactor control | + | + | + | + |
| Control of automatic circuit breakers with magnetic drives |  |  | + | + |
| Control of automatic circuit breakers with motor-drives |  |  | + | + |
| Control of load breakers with motor-drives |  |  | + | + |
| Type of input |  |  |  |  |
| Power supply of the main and the backup input from a voltage transforming plant | + | + | + | + |
| Power supply of one of the inputs from the power generating unit |  |  |  | + |
| Functional characteristics |  |  |  |  |
| Voltage control | + | + | + | + |
| Phase loss control | + | + | + | + |
| Phase sequence control | + | + | $+$ | + |
| Voltage unbalance monitoring | + | + | + | + |
| Alarm indication | + | + | + | + |
| Option to connect an external alarm device via dry contacts of the relay |  |  | + | + |
| Option of remote locking of front panel buttons |  |  | + | + |
| Supported number of inputs | 2 | 2 | 2 | 2 |
| Supported number of controllable switching devices | 2 | 3 | 4 | 3 |
| Inputs status indication | + | + | + | + |
| "On/off" status indication of switching devices |  |  | + | + |
| "Emergency shutoff", "removed" status indication of switching devices |  |  | + | + |
| LCD display |  |  | + | + |
| Control and dispatching via Modbus |  |  | + | + |
| Mounting |  |  |  |  |
| on a DIN-rail | + | + | + | + |
| on a mounting panel | + | + |  |  |
| on the switchboard door |  |  | + | + |
| Degree of protection in compliance with the requirements of GOST 14254 |  |  |  |  |
| by the case, from the front panel | IP 20 |  | IP 54 | IP 54 |
| by the terminals | IP 20 |  | IP 20 | IP 20 |
| Electromagnetic compatibility |  |  |  |  |
| Classification of operating conditions in compliance with the requirements of GOST R 51317.4.5 | - |  | Level 3 | Level 3 |
| Impulse noise and overvoltage immunity per GOST R 51317.4.5 | - |  | Level 3 | Level 3 |
| Electrostatic discharge immunity per GOST 30804.4.2 | - |  | Level 3 | Level 3 |
| Operating temperature range, ${ }^{\circ} \mathrm{C}$ | from +1 to +40 |  | from -40 to +45 | from -40 to +45 |

## OptiSave L Automatic transfer unit of lighter functional characteristics



Automatic transfer unit OptiSave $L$ is meant for constructing various budget solutions based on contactors.

## Batch effectiveness



Ease of setup. Setting of the units is carried out from the front panel, specialized SOFTWARE or additional tools are not required.


Ensured compatibility with contactors of OptiStart K, ПМЛ, OptiDin MK series.

Manufactured in Russia.
Suitable for import substitution.


Ease of installation. Compact sizes, can be mounted on a DIN-rail or a mounting panel.

Ease of operation. Indication of the input status and emergency modes on the front panel.


Adjustable hysteresis. Avoidance of loops in "weak" networks.

## Technical specifications

| Parameter | Value |  |
| :---: | :---: | :---: |
| Version | OptiSave L-220 | OptiSave L-230 |
| Type of the switched line | three-phase four-wireL1, L2, L3, N |  |
| Number of the switched devices | 2 | 3 |
| Rated operational voltage (Ue), V | 220/380 |  |
| Network power frequency (f), Hz | 50 |  |
| Overvoltage tripping setpoints (phase type) «> $\mathrm{U}_{\mathrm{B}}$, V | $230 . . .270$ |  |
| Undervoltage tripping setpoints (phase type) <>> $\mathrm{U}_{\mathrm{H}} \gg, \mathrm{V}$ | 150 ... 200 |  |
| Hysteresis of the low threshold $\left\langle\Delta \mathrm{U}_{H}\right\rangle, \mathrm{V}$ | 5 ... 30 |  |
| Phase skew « $U_{B}-U_{H}$ 》, V | $10 . . .100$ |  |
| Trip delay of the main input relay in the event of the controlled parameters exceeding the allowable range ( $\mathrm{t}_{\text {откл }}$ ), s | 0 ... 20 |  |
| Delayed actuation of the automatic transfer relay ( $\mathrm{t}_{\text {вкл }}$ ), s | $0 \ldots 10$ |  |
| Delayed reverse switching to the main input in the event of the parameter recovery $\left(\mathrm{t}_{\text {возвр }}\right)$, s | without reverse switching | 0 ... 10 |
| Maximum load current of AC1 application category at the voltage of $250 \mathrm{~V}, \mathrm{~A}$ | 5 *) |  |
| Commutation life, cycles | $>10^{6}$ |  |
| Overall dimensions, mm | $71 \times 90 \times 65$ |  |
| Weight, not more, kg | 0,3 |  |

*) it is recommended to apply protection circuits against commutation surges, the universal parameters are 100 Ohm and $0.1 \mu \mathrm{~F}$

## Operational environment

OptiSave L is manufactured in the climatic version of UHL with the location class 4 in compliance with the requirements of GOST 15150 and is designed for operation under the conditions specified in the table.

| Parameter | Value |
| :--- | :---: |
| Operating temperature range, ${ }^{\circ} \mathrm{C}$ | $+1 \ldots+40$ |
| Degree of the environment pollution in accordance with GOST 9920 | 2 |
| Relative air humidity at $25^{\circ} \mathrm{C}, \%$ | up to 80 |
| Altitude above the sea level, m | up to 2000 |
| Rated operating values of mechanical exposure factors in accordance with GOST 30631 | M4 |
| Protection class of EMC in accordance with GOST R 51318.14.1 | 0 |
| Operating position | arbitrary |
| Operating mode | prolonged |
| Degree of protection in accordance with GOST 14254 | IP20 |

## Meaning of controls and LEDs

On the front panel of the high-speed automatic transfer device (HSTD) (figure 1) there are control knobs for setting the relay operation mode and the network status indicators for input 1 and input 2. In the upper and lower parts of the high-speed automatic transfer device, there are terminal blocks (TB) for connecting external circuits to the HSTD (high-speed automatic transfer device).

## Front panel of the OptiSave L-220



## Front panel of the OptiSave L-230



Indication of operating modes by LEDs placed on the front panel

| LED type |  |
| :--- | :--- |
| «P1» (green) | Relay P1 is actuated |
| «P2» (green) | Relay P2 is actuated |
| «L1», <L2», <L3» (green) | The input voltage corresponds to the set parameters |
| «<UH» (red) | The input voltage is below the set threshold value/phase skew |
| «>UB» (red) | The input voltage is higher than the set threshold value/phase skew |

## Timing diagrams and operation description

## Timing diagram of OptiSave L-220



## OptiSave L-220 operation description

After the power has been applied to the device, when the mains voltage is within the allowable range, LEDs L1, L2, L3-"LINE 1" and L1, L2, L3 - "LINE 2" are activated. Then, with the delay of $\mathrm{t}_{\mathrm{BkN} \boldsymbol{r}}$, the input relay 1 is actuated, LED "P1" is turned on, and the power is supplied to the load.

If during the connection of the controlled network, the sequence of the phases on "LINE 1" or "LINE 2" inputs has been broken, "L2", "L3" LEDs of the corresponding input flash.

In the event of a fault on input 1 (the voltage at any phase is less than the tripping setpoint when the voltage is low "<UH"), the "<U" LED is turned on, after the tripping time delay $\mathrm{t}_{\text {ořn }}$ count has been performed, LED "P1" and LED L1, L2, L3 corresponding to the emergency phase are turned off. Then the input relay 1 is actuated and the load is cut off from input 1 . If the voltage at any of the phases is above the tripping setpoint at an increased voltage "> UB", "> U" LED is turned on and the tripping goes without delay. If the voltage on the input "LINE 2" is within the norm, then after the $\mathrm{t}_{\mathrm{BK}}$ the input relay 2 is actuated, "P2" LED is turned on and the load is connected to "LINE 2". When the power supply is recovered on the input "LINE 1 " after the release time $-\mathrm{t}_{\text {возвр }}$ switching to input "LINE 1" is performed.

The tripping time $-\mathrm{t}_{\text {orкй }}$ - is set in such a way that in the case of short-term voltage slumps on the line with the duration $\mathrm{t}<\mathrm{t}_{\text {orкл }}$, there was no switching of the line.

In the event of a phase loss on "LINE 1", the actuation of input relay 1 and the disconnection of the load from input 1 occur without any time delay, and the actuation of input relay 2 and the load connection - with the make-time delay $-\mathrm{t}_{\text {вкл }}$.

## Timing diagram of OptiSave L-230



KM - commutation mechanism (a contactor, a starter) (CM)

## OptiSave L-230 Operation description

After the power has been supplied to the device, when the mains voltage is within the allowable range, LEDs L1, L2, L3- "LINE 1 " and L1, L2, L3 - "LINE 2" are activated. Then, with the delay of the make time $-\mathrm{t}_{\text {вкл }}$, the input relay 1 and the input relay 2 are actuated, LEDs "P1" and "P2" are turned on.

If during the connection of the controlled network, the sequence of the phases on "LINE 1" or "LINE 2" inputs has been broken, "L2", "L3" LEDs of the corresponding input flash.

In the event of a fault on input 1 or input 2 (the voltage at any phase is less than the tripping setpoint when the voltage is low " $<\mathrm{UH}$ "), the " $<\mathrm{U}$ " LED is turned on, after the tripping time delay $-\mathrm{t}_{\text {откл }}$ - count has been performed, emergency input relays (P1 or P2) are disconnected. If the voltage at any of the phases is above the tripping setpoint at an increased voltage "> UB", "> U" LED is turned on and the tripping goes without delay. Further on, with a delay determined by the make-time setpoint $-\mathrm{t}_{\text {Вкл }}$ input relay P3 is actuated, that controls the activation of the sectionilizing switch device.

When the voltage on the emergency input is recovered with a delay determined by the setpoint tвозвр., the relay P3 is disconnected and the corresponding relay P1 or P2 are actuated. The high-speed ATS returns to the initial condition.

## Impending faults of OptiSave L and ways of their elimination

| Impending fault | Cause | Troubleshooting |
| :--- | :--- | :--- |
| No indication at switching on the <br> network | Contact fault in the terminal block | Disconnect the network and check the quality of the contacts <br> in the terminal block |
|  | Malfunction in the scheme of the high-speed <br> ATS | Disconnect the network, dismount the high-speed ATS and <br> contact the services department of the manufacturer |
| No indication of one of the operating <br> modes | Abnormal LED | Disconnect the network, dismount the high-speed ATS and <br> contact the services department of the manufacturer |

## Connection diagrams

The solution is advisory. The manufacturer of the LVCD, conducting acceptance tests, is held liable for the performance of the LVCD on the basis of the given complex, in compliance with the requirements of GOST R 51321-2007. KEAZ reserves the right to introduce changes in this document, as well as the materials specified in it, without prior notice.

## A recommended connection diagram for connecting switchgear to a high-speed ATS

 OptiSave L-220

Q1, Q2 - automatic circuit breakers;
KM1, KM2 - commutation mechanisms (contactors, starters);
RC - protection circuit against commutation surges.

- A recommended connection diagram for connecting switchgear to a high-speed ATS OptiSave L-230


Q1, Q2 - automatic circuit breakers;
KM1, KM2, KM3 - commutation mechanisms (contactors, starters);
RC - protection circuit against commutation surges.

## Overall and mounting dimensions (mm)


a) mounting dimensions of the high-speed ATS connecting elements for panel mounting type
b) mounting panel cutout

- OptiSave L-230

a)
a) mounting dimensions of the high-speed ATS connecting elements for panel mounting type б) mounting panel cutout


## OptiSave H Automatic transfer unit of exteded functional characteristics



OptiSave H automatic transfer switch unit is designed to build various ATS functional solutions based on contactors, load switches and electromagnetic and motor driven circuit breakers with the option of being integrated into dispatching systems via Modbus protocol.

## Batch effectiveness



Simple and quick installation both on the switchboard door and on the DIN rail.


- Electromagnetic interference resistance and low interference emission.
- Temperature range: -40 to $+45^{\circ} \mathrm{C}$.
- Protection class: IP54 (front panel).


Remote control \& dispatching via Modbus.


Compatibility with KEAZ switching equipment.

Made in Russia. Suitable for import substitution.


Shock-proof, front panel locking, password setting.


Great configurability potential for various tasks that requires no programming skills, algorithm flexibility.


Network and switching equipment status is displayed on LCD display, mnemonic diagram.

## Technical specifications

| Parameter | Value |
| :---: | :---: |
| Type of the switched line | three-phase four-wire L1, L2, L3, N |
| Number of the switched devices | 2 |
| INPUT 1 and INPUT 2 supply voltages ( $\mathrm{U}_{\mathrm{e}}$ ), B | 180... 400 |
| AC frequency across input terminals (f), Hz | 50 |
| Maximum switching voltage at 50 Hz 5 A AC, V | 400 * |
| Maximum load current of AC1 utilization category at $250 \mathrm{~V}, \mathrm{~A}$ | 16 * |
| Overvoltage trip settings for INPUT 1 and INPUT $2\left(\mathrm{U}_{\text {max }}\right), \mathrm{V}$ | $235 . .280^{1)}$ |
| Undervoltage trip settings for INPUT 1 and INPUT $2\left(\mathrm{U}_{\text {min }}\right), \mathrm{V}$ | 165 ... $2225^{\text {1) }}$ |
| Trip settings for input phases voltage unbalance ( $\mathrm{U}_{\mathrm{as}}$ ), V | $10 . . .115^{\text {1) }}$ |
| Voltage hysteresis ( $\mathrm{U}_{\mathrm{h}}$ ), V | $5 . .15^{1)}$ |
| Switching device switch-on time settings ( $\mathrm{t}_{\text {sw }}$ ), s | $0,1 \ldots 360{ }^{\text {3) }}$ |
| Infinite loop protection time settings ( $\mathrm{t}_{\text {loop }}$ ), c | 0,1 ... $900{ }^{\text {3) }}$ |
| Trip time settings for voltage over $\mathrm{U}_{\text {max }}\left(t_{\text {trip.u.max }}\right)$, s | 0,1 ... $900{ }^{3)}$ |
| Trip time settings for voltage under $\mathrm{U}_{\text {min }}\left(\mathrm{t}_{\text {trip.u.min }}\right)$, $s$ | 0,1 ... $900{ }^{\text {3) }}$ |
| Trip time settings for phase reversal failure ( $t_{\text {trip.ph.r.s }}$ ), $s$ | 0,1 ... $900{ }^{3)}$ |
|  | 0,1 ... $900{ }^{\text {3) }}$ |
| Commutation life, cycles | > 106 |
| Overall dimensions, mm | $155 \times 155 \times 72$ ** |
| Weight, not more, kg | 0,85 |
| * use of switching surge protection circuits is recommended; <br> ** overall and connection dimensions for mounting on a TN35 rail in accordance with GOST R IEC 60715 or for mounting in a window on a panel are given in Appendix B; <br> 1) parameter setting step: 5 V ; <br> 2) parameter setting step: 1 Hz ; <br> 3) parameter setting step: <br> $-0,1 \mathrm{~s}$ in the 0,1 to 1 s range; <br> -1 s in the 1 to 10 s range; <br> -5 s in the 10 to 100 s range; <br> - 20 s in the 100 to 400 s range; <br> - 50 s in the 400 to 1000 s range. |  |

Attention! The ATSU does not provide for frequency control and the frequency in the range from 40 to 65 Hz is considered the norm by default.

## Modbus protocol data transmission parameters

| Parameter | Value |
| :---: | :---: |
| Physical protocol | RS-485 |
| Data transfer protoco | Modbus RTU |
| Supported access addresses | 1... 247 |
| Data transfer rate, bit/s | 9600 |
| Stop bit | 1 |
| Parity | NONE |

## Operational environment

| Parameter | Value |
| :---: | :---: |
| Operating temperature range, ${ }^{\circ} \mathrm{C}$ | $-40 \ldots+45$ |
| Environmental pollution degree according to GOST IEC 60947-1 | 3 |
| Relative air humidity, \% | up to 98 (at $25^{\circ} \mathrm{C}$ ) |
| Height above the sea level, m | up to 2000 |
| Nominal working values of mechanical influencing factors according to GOST 30631 | M4 |
| Electrostatic discharge immunity per GOST 30804.4.2 (IEC 61000-4-2) | Level 3 |
| Nanosecond impulse noise immunity in accordance with GOST 30804.4.4 (IEC 61000-4-4) | Level 3 |
| High-energy microsecond impulse noise immunity in accordance with GOST R 51317.4 .5 (IEC 61000-4-5) | Level 3 |
| Immunity from voltage dips and short interruptions in accordance with GOST 30804.4.11 (IEC 61000-4-11) | Level 3 |
| Operating position | arbitrary |
| Operating mode | continuous |
| $\begin{array}{\|ll} \hline \text { Protection class as per GOST } 14254 \\ - & \text { housing } \\ - & \text { terminals } \end{array}$ | $\begin{aligned} & \text { IP54 } \\ & \text { IP20 } \end{aligned}$ |

## Purpose of controls and LEDs

The ATSU is an independent device and features a housing made of non-combustible thermoplastic material, printed circuit boards with electronic components placed inside it, and fasteners.

The controls and indication elements are placed on the front panel, and connectors for connecting external devices are placed on the patch panels.
The front panel of the ATSU has is a mnemonic scheme, LCD-indicator, LED indicators of phase voltages, voltage thresholds, readiness of inputs, switching devices status, alarm state and control buttons.

## Front panel of the OptiSave H-243



## Upper patch panel of OptiSave H-243

The upper patch panel of the ATSU contains contains connectors for connecting power supply inputs ("INPUT 1" and "INPUT 2"), external operational power supply Uoper, a bus for data transmission via the Modbus protocol and an external alarm device.


## Lower patch panel of OptiSave H-243

The lower patch panel contains connectors for connecting an external alarm device, control contacts for external switching devices, as well as for control devices for switching devices. Purpose of the "X12" connector contacts is shown in the table.


## Purpose of inputs X12

| Contact <br> number |  |
| :---: | :--- |
| C | Common |
| 1 | Status of switching device of INPUT 1 When closed, it signals the ON state of the INPUT 1 switching device. |
| 2 | Emergency trip contact. When closed, it signals the emergency trip of INPUT 1 safety device. |
| 3 | "Removed" status contact. In the closed state, it signals the removal of INPUT 1 switching device (withdrawable version). |
| 4 | Status of switching device of INPUT 2 When closed, it signals the ON state of the INPUT 2 switching device. |
| 5 | Emergency trip contact. When closed, it signals the emergency trip of the safety device of INPUT 2. |
| 6 | "Removed" status contact. In the closed state, it signals the removal of INPUT 2 switching device (withdrawable version). |
| 7 | Status of the sectional switching device When closed, it signals the ON state of the sectional switching device. |
| 8 | Emergency trip contact. When closed, it signals the emergency trip of the sectional safety device. |
| 9 | "Removed" status contact. In the closed state, it signals the removal of sectional switching device (withdrawable version). |
| 10 | Non-priority load switching device status When closed, it signals the ON state of the non-priority load switching device. |
| 11 | Front panel locking. In the closed state, it locks the control buttons on the module's front panel. |

Note: Inputs of the X12 connector are discrete. Combining the neutral and terminal "C" of connector X12 can cause the device to malfunction. Use a voltmeter to diagnose the connector, - a voltage in the range from 0 to 3.2 V between the diagnosed contact and the common contact " C " indicates the closed state of the corresponding contact.

## Timing diagrams and operation description

The ATSU has 2 operating modes: manual and automatic. By default, the ATSU is switched on in the manual mode.
In the automatic and manual ATSU operation modes, background control of the parameters of the inputs and switching devices is carried out. The voltage is measured separately for each phase of each input.

The decision about the input readiness is made under the following conditions:

- the voltage of each input phase does not exceed the value of the difference of setpoint $U_{\text {max }}$ and the hysteresis value $\left(U_{h}\right)$ for a time greater than the setpoint value $\mathrm{t}_{\text {оккл } \mathrm{u} . \text { max }}{ }^{i}$
- the voltage of each input phase is not less than the sum of the setpoint $U_{\text {min }}$ and the hysteresis value $\left(U_{h}\right)$ for a time greater than the setpoint value $\mathrm{t}_{\text {откл } \mathbf{u} \text {. min }}$.
- the voltage difference between the input phases does not exceed the setpoint value $U_{\text {as }}$ for a time greater than the setpoint value $t_{\text {orkr. as. } \phi \text {. }}$.
- in the presence of input phase alternation during the setpoint time $\mathrm{t}_{\text {откл. }}$.


## Timing diagram in automatic mode with overvoltage, undervoltage of the input and phase asymmetry with the enabled "non-priority load control in automatic mode" function



The decision about the failure of the switching device (SD) is made when the SD status changes without the ATSU issuing controlling actions. The ATSU in the automatic mode does not restore the SD's health attribute without the operator's intervention. After the SD failure causes have been eliminated, error reset must be performed in the ATSU menu. In the presence of the "SD Deleted" signal, the ATSU operation algorithm is blocked.

## Automatic mode

The ATSU is switched to the automatic mode by pressing the "AUTO" button for 5 seconds (the corresponding LED will light up). When the ATSU operates in automatic mode, the power supply parameters on inputs 1 and 2 are checked. If the monitored parameters are within the set limits, the ATSU, with a delay of ton (ON time) connects the loads to the corresponding inputs via relays "Q1" and "Q2". In case of failure on one of the inputs, the load is disconnected from the faulty input and connected to the serviceable input through bus section breaker "Q3". When the power supply is restored to the emergency input, with the self-recovery mode ("Input recovery - AUTO") enabled, the ATSU goes to the mode that preceded the emergency: the bus section breaker is turned off, and after the time ton the load is connected to the recovered input. If the non-priority load control mode is enabled, then simultaneously with the sectional switching device, the non-priority load device "Q4" will change its status (it will turn off when the bus section breaker is turned on, and turn on when the bus section breaker is turned off).

Attention! If, in the event of a failure at INPUT 1, the ATSU is switched to INPUT 2, which is also in an failure state, the ATSU turns off the switching devices KM1 and KM2, the "FAILURE" indicator on the front panel turns on and the "dry" contact for controlling the external alarm device is closed.

## Manual mode

Switching to manual mode is done by pressing the "AUTO" button when the automatic mode is active or via Modbus protocol. During this switching, the power supply parameters are monitored. The manual mode is used to switch on the selected input directly using the front panel buttons "Q1" or "Q2" and to switch on the bus section breaker using the button "Q3".

INPUT recovery in manual mode can be done under the following conditions:

- "Recover input in manual mode" is enabled in the ATSU settings;
- the INPUT is operational and ready (green LED is on);
- the switching device of the corresponding INPUT is operational;
- the sectional switching device is open.

Recovery occurs while button "Q1" or "Q2" respectively is held down for more than 2 seconds.
The manual operation option for the sectional SD is set in the ATSU menu ("Manual Section Control" parameter). The sectional SD is used to connect the load of the faulty INPUT to the serviceable INPUT. The SD is turned on/off by pressing the "Q3" button for more than 2 seconds.
Attention! In manual mode, the ATSU allows the simultaneous switching on of the INPUTS and the section (provided that the section control is allowed in the ATSU menu and the SD is operable), therefore, this function can lead to an emergency situation associated with a short circuit of two inputs and the loss of the facility!

## Resetting errors and alarms

If necessary, the errors and accidents that occurred during the operation of the ATS can be reset from the appropriate menu of the ATSU.

## Indication

Operation modes are indicated by an LCD indicator and LED indicators both in automatic mode and in manual control mode.
The indication displayed on the front panel can be duplicated by signals on external ATS unit connectors and via Modbus protocol.

| № | Failure category | Possible cause | Signaling methods | Troubleshooting method |
| :---: | :---: | :---: | :---: | :---: |
| 1 | malfunction of the three-phase line of one or two inputs | 1) unacceptable voltage deviation in the phases; <br> 2) change in phase sequence, emergence of phase asymmetry; <br> 3) breakage of one or more phases; redundancy switching. | 1) turning on the LED " $U>$ " or " $U<$ "; <br> 2) flashing of phase indicators "L1", "L2", "L3"; <br> 3) the indicator of the corresponding phase has gone off <br> 4) in all types of faults switching on of the <br> "Failure" LED, closure of the "dry" contact <br> "Failure", switching off of the indicator <br> "Ready", message on the LCD-indicator. | elimination of the fault in the faulty threephase line |
| 2 | switching device control | change in SD status without the ATSU issuing controlling actions | The ATSU recognizes such an SD as faulty and a red LED of the corresponding SD lights up. Switching on of the "Failure" LED, closure of the "dry" contact "Failure", message on the LCD-indicator. | elimination of inconsistencies and error resetting through the menu |
| 3 | removing the switching device | "SD removed" signal | turning on of the LEDs "Failure", "Deleted", "dry" contact "Failure" | switching device recovery |
| 4 | failure on the line of one or two inputs | short circuit, overload or other emergency situation that caused the circuit breaker to trip and its emergency contacts to close | flashing red LED of the corresponding SD. switching on of the "Failure" LED, closure of the "dry" contact "Failure", switching off of the "Ready" indicator, message on the LCD indicator | elimination of the failure and error resetting through the menu |

For a more detailed description of the menu, settings and connections of the ATSU, see the operation manual.

## Connection diagrams

## Recommended connection diagram of electromagnetic switching devices to ATSU



KM1, KM2, KM3, KM4 - switching devices (contactors, starters);
KM1.1, KM2.1 - contacts blocking section switching device switch-on; KM1.2, KM1.3, KM2.2, KM2.3, KM3.2, KM3.3, KM4.2 - signal contacts of switching devices;
KM5 - relays for switching the power supply of external control and signaling devices;
KM5.1, KM5.2 - contacts for blocking simultaneous connection to inputs;
FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - signaling "Switching device of Input 1 is on";

HL3 - signaling "Input 1 switching device off"; HL4 - signaling "Switching device of Input 2 on"; HL5 - signaling "Switching device of Input 2 off"; HL6 - signaling "sectional switching device on"; HL7 - signaling "sectional switching device off"; HL8 - signaling "ATSU in automatic mode"; HL9 - signaling "ATSU in manual mode"; HL10 - indicator "Norm";
HL11 - indicator "Failure";
S1 - front panel locking.

## Recommended connection diagram of motor-driven circuit breakers to ATSU



Q1, Q2, Q3, - automatic circuit breakers;
MP1, MP2, MP3 - motor drives for breakers Q1, Q2, Q3; MP4 - motor drive of the non-priority load breaker; Q1.1, Q2.1 - section switch closure blocking contacts;
Q1.2, Q2.2, Q3.2, Q4.2 - switching devices status control;
Q1.3, Q2.3, Q3.3 - control of emergency operation of circuit breakers Q1.4, Q2.4, Q3.4 - "Removed" status contact;
KM9 - relays for switching the power supply of external control and signaling devices;
KM9.1, KM9.2 - contacts for blocking simultaneous connection to inputs;
FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - indicator "Switching device of Input 1 is on";
HL3 - indicator "Input 1 switching device off";
HL4 - indicator "Input 1 switching device removed";
HL5 - indicator "Input 1 switching device installed";

HL6 - indicator "Input 1 switching device tripped automatically"; HL7 - indicator "Input 1 switching device in normal mode";
HL8 - indicator "Input 2 switching device on";
HL9 - indicator "Input 2 switching device off";
HL10 - indicator "Input 2 switching device removed";
HL11 - indicator "Input 2 switching device installed";
HL12 - indicator "Input 2 switching device tripped automatically";
HL13 - indicator "Input 2 switching device in normal mode";
HL14 - indicator "sectional switching device on";
HL15 - indicator "sectional switching device off";
HL16 - indicator "sectional switching device removed";
HL17 - indicator "sectional switching device installed";
HL18 - indicator "ATSU in auto mode";
HL19 - indicator "ATSU in manual mode";
HL20 - "Failure" indicator;
HL21 - "Norm" indicator;
S1 - front panel locking.

## Recommended connection diagram of electromagnetic-driven circuit breakers to ATSU



Q1, Q2, Q3, - automatic circuit breakers;
EM1, EM2, EM3 - electromagnetic drives of breakers Q1, Q2, Q3;
EM4 - motor drive of the non-priority load breaker;
Q1.1, Q2.1 - contacts blocking bus section breaker switch-on;
Q1.2, Q2.2, Q3.2, Q4.2 - switching devices status control;
Q1.3, Q2.3, Q3.3 - control of emergency operation of circuit breakers;
Q1.4, Q2.4, Q3.4 - "Removed" status contact;
S1 - front panel locking;
KM9 - relays for switching the power supply of external control and signaling devices;
KM9.1, KM9.2 - contacts for blocking simultaneous connection to inputs ;
FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - indicator "Input 2 switching device on";
HL3 - indicator "Input 2 switching device off";
HL4 - indicator "Input 1 switching device removed";

HL5 - indicator "Input 1 switching device installed";
HL6 - indicator "Input 1 switching device tripped automatically";
HL7 - indicator "Input 1 switching device in normal mode";
HL8 - indicator "Input 2 switching device on";
HL9 - indicator "Input 2 switching device off";
HL10 - indicator "Input 2 switching device removed";
HL11 - indicator "Input 2 switching device installed";
HL12 - indicator "Input 2 switching device tripped automatically";
HL13 - indicator "Input 2 switching device in normal mode";
HL14 - indicator "sectional switching device on";
HL15 - indicator "sectional switching device off";
HL16 - indicator "sectional switching device removed";
HL17 - indicator "sectional switching device installed";
HL18 - indicator "ATSU in auto mode";
HL19 - indicator "ATSU in manual mode";
HL20 - "Failure" indicator;
HL21 - "Norm" indicator;
S1 - front panel locking.

## Purpose of controls and LEDs of OptiSave H-233-G

The ATSU is an independent device and features a housing made of non-combustible thermoplastic material, printed circuit boards with electronic components placed inside it, and fasteners.

The controls and indication elements are placed on the front panel, and connectors for connecting external devices are placed on the patch panels.
The front panel of the ATSU has is a mnemonic scheme, LCD-indicator, LED indicators of phase voltages, voltage thresholds, readiness of inputs, switching devices status, alarm state and control buttons.

## Front panel of OptiSave H-233-G



## Appearance of the upper patch panel of OptiSave H-233-G

The upper patch panel of the ATSU contains contains connectors for connecting power supply inputs ("INPUT 1" and "INPUT 2"), external operational power supply $\mathrm{U}_{\text {onep, }}$, a bus for data transmission via the Modbus protocol and an external alarm device. The appearance of the top patch panel and the location and function of the connectors are shown in the illustration below.


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## Appearance of the lower patch panel of OptiSave H-233-G

The lower patch panel contains connectors for connecting an external alarm device, control contacts for external switching devices, as well as for control devices for switching devices. The appearance of the lower patch panel and the location and function of the connectors are shown in the illustration below. Purpose of the "X12" connector contacts is shown in the table.


## Purpose of inputs X12

| Contact <br> number |  |
| :---: | :--- |
| C | Common |
| 1 | Status of switching device of INPUT 1 When closed, it signals the ON state of the INPUT 1 switching device. |
| 2 | Emergency trip contact. When closed, it signals the emergency trip of INPUT 1 safety device. |
| 3 | "Removed" status contact. In the closed state, it signals the removal of INPUT 1 switching device (withdrawable version). |
| 4 | Status of switching device of INPUT 2 When closed, it signals the ON state of the INPUT 2 switching device. |
| 5 | Emergency trip contact. When closed, it signals the emergency trip of the safety device of INPUT 2. |
| 6 | "Removed" status contact. In the closed state, it signals the removal of INPUT 2 switching device (withdrawable version). |
| 7 | Status of the sectional switching device When closed, it signals the ON state of the non-priority load switching device. |
| 8 | Emergency trip contact. When closed, it signals the emergency disconnection of the non-priority load switching device. |
| 9 | "Removed" status contact. In the closed state, it signals the removal of non-priority load switching device (withdrawable version). |
| 10 | Not used |
| 11 | Front panel locking. In the closed state, it locks the control buttons on the module's front panel. |

Note: Inputs of the X12 connector are discrete. Combining the neutral and terminal "C" of connector X12 can cause the unit to malfunction.
Use a voltmeter to diagnose the connector - a voltage in the range from 0 to $3,2 \mathrm{~V}$ between the diagnosed contact and the common contact " C " indicates the closed state of the corresponding contact.

## Timing diagrams and operation description

The ATSU has 2 operating modes: manual and automatic. By default, the ATSU is switched on in the manual mode.
In the automatic and manual ATSU operation modes, background control of the parameters of the inputs and switching devices is carried out. The voltage is measured separately for each phase of each input.

The decision about the input readiness is made under the following conditions:

- the voltage of each input phase does not exceed the value of the difference of setpoint $U_{\text {max }}$ and the hysteresis value $\left(U_{h}\right)$ for a time greater than the setpoint value $\mathrm{t}_{\text {откл } \text {. max }}{ }^{\text {i }}$
- the voltage of each input phase is not less than the sum of the setpoint $U_{\text {min }}$ and the hysteresis value $\left(U_{h}\right)$ for a time greater than the setpoint value
$\mathrm{t}_{\mathrm{onn}}$
- the voltage difference between the input phases does not exceed the setpoint value $U_{a s}$ for a time greater than the setpoint value $t_{\text {orrл. as. } \text {. } \text {. }}$.
- in the presence of input phase alternation during the setpoint time $\mathrm{t}_{\text {откл. ч. ф. }}$
- Timing diagram of ATSU operation in AUTO mode with the preset INPUT 2 value of mains using the example of voltage loss on INPUT 1


Timing diagram of ATSU operation in AUTO mode with the preset INPUT 2 value of generator using the example of voltage loss on INPUT 1


The decision about the failure of the switching device (SD) is made when the SD status changes without the ATSU issuing controlling actions. The ATSU in the automatic mode does not restore the SD's health attribute without the operator's intervention. After the SD failure causes have been eliminated, error reset must be performed in the ATSU menu.

In the presence of the "SD Deleted" signal, the ATSU operation algorithm is blocked.

## Automatic mode

The ATSU is switched to the automatic mode by pressing the "AUTO" button for 5 seconds (the corresponding LED will light up).
The logic of the ATSU operation in AUTO mode depends on the following settings:

1. INPUT priority. If there is a priority, the ATSU checks the readiness of the priority INPUT. If this INPUT is ready, the ATSU turns on the corresponding SD. Otherwise, the ATSU sets the the failure attribute, turns off the priority INPUT SD and waits for the standby INPUT to become ready for turning on the standby INPUT SD and connect the priority load.

If the user has not set the INPUT's priority, when switching to the "AUTO" mode, the ATSU does not attempt to switch the load to the priority INPUT. If at this moment of time both INPUTS are operational and ready and no SD is switched on, ATSU will connect the load to INPUT 1. Otherwise, the ready and operational INPUT will remain connected.
2. INPUT 2 type There are 2 configurable options for INPUT 2 - Mains and Generator. In the "Mains" mode, INPUT 2 behaves symmetrically to INPUT 1. In the "generator" mode, the ATSU controls the start and stop of the generator, handles the time settings. The generator is started by closing the "dry" contact of connector X22. The generator is stopped by opening the "dry" contact of connector X22. The ATSU counts the generator warm-up time, generator cooling time, controls the output voltage, gives or removes the generator on/off commands and controls the SD of the corresponding INPUT.
3. Presence of non-priority load. The user can indicate the presence of a non-priority load and the INPUT to which it is connected. If there is a non-priority load, the corresponding load SD is switched on/off symmetrically with the selected input.

ATTENTION! If INPUT priority is specified, and a there is a non-priority load indicated to be present on the standby INPUT, the non-priority load SD will never turn on, since, in accordance with the ATSU operation logic, when a load is connected to the reserve INPUT, the non-priority load must be disconnected!

## Manual mode

Switching to manual mode is done by pressing the "AUTO" button when the automatic mode is active or via Modbus protocol. During this switching, the power supply parameters are monitored. The manual mode is used to switch on the selected input directly using the front panel buttons "Q1" or "Q2" and to switch on the generator using the button " G ".
INPUT recovery in manual mode can be done under the following conditions:

- "Recover input in manual mode" is enabled in the ATSU settings;
- the INPUT is operational and ready (green LED is on);
- The switching device of the corresponding INPUT is operational.

Recovery occurs while button "Q1" or "Q2" respectively is held down for more than 2 seconds.
ATTENTION! Simultaneous switching on of switching devices is impossible to eliminate short-circuit. When the switching device is turned on, a check is made for the status of the opposite switching device and, if necessary, it is turned off.

## Resetting errors and alarms

If necessary, the errors and accidents that occurred during the operation of the ATS can be reset from the appropriate menu of the ATSU.

## Indication

In the normal operating mode in the switched SD state, the LED of the corresponding SD is lit green. In the off state, the SD LED is off. Flashing green LED indicates the process of the SD turning on.
The "FAILURE"Indicator turns on in case of any emergency situation (busbar breakage, phase reversal failure, no voltage, voltage out of the specified range, switching to standby). The "FAILURE" indicator turns off automatically after the normal parameters of the monitored network are restored. Indication of emergency operation modes is shown in the table.
The indication displayed on the front panel can be duplicated by signals on external ATS unit connectors and via Modbus protocol.

| № | Failure category | Possible cause | Signaling methods | Troubleshooting method |
| :---: | :---: | :---: | :---: | :---: |
| 1 | malfunction of the three-phase line of one or two inputs | 1) unacceptable voltage deviation in the phases; <br> 2) change in phase sequence, emergence of phase asymmetry; <br> 3) breakage of one or more phases; <br> 4) redundancy switching. | 1) turning on the LED " $U>$ " or " $U<$ "; <br> 2) flashing of phase indicators "L1", "L2", "L3"; <br> 3) the indicator of the corresponding phase has gone off <br> 4) in all types of faults switching on of the "Failure" LED, closure of the "dry" contact <br> "Failure", switching off of the indicator <br> "Ready", message on the LCD-indicator. | elimination of the fault in the faulty threephase line |
| 2 | switching device control | change in SD status without the ATSU issuing controlling actions | The ATSU recognizes such an SD as faulty and a red LED of the corresponding SD lights up. Switching on of the "Failure" LED, closure of the "dry" contact "Failure", message on the LCD-indicator. | elimination of inconsistencies and error resetting through the menu |
| 3 | removing the switching device | "SD removed" signal | turning on of the LEDs "Failure", "Deleted", "dry" contact "Failure" | switching device recovery |
| 4 | failure on the line of one or two inputs | short circuit, overload or other emergency situation that caused the circuit breaker to trip and its emergency contacts to close | flashing red LED of the corresponding SD. switching on of the "Failure" LED, closure of the "dry" contact "Failure", switching off of the "Ready" indicator, message on the LCD indicator | elimination of the failure and error resetting through the menu |

For a more detailed description of the menu, settings and connections of the ATSU, see the operation manual

## Connection diagrams

## Recommended connection diagram of electromagnetic switching devices to ATSU



KM1, KM2, KM3 - switching devices (contactors, starters);
KM1.1, KM1.2 -contacts for blocking simultaneous switching on of input SDs
KM1.2, KM2.2, KM3.2 - signaling contacts of switching devices;
KM5 - relays for switching the power supply of external control and signaling
devices;
KM5.1, KM5.2 - contacts for blocking simultaneous connection to inputs;
FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - signaling "Switching device of Input 1 on";
HL3 - signaling "Switching device of Input 1 off";

HL4 - signaling "Switching device of Input 2 on";
HL5 - signaling "Switching device of Input 2 off";
HL6 - signaling "non-prriority switching device on";
HL7 - signaling "non-prriority switching device off";
HL8 - signaling "ATSU in auto mode";
HL9 - signaling "ATSU in manual mode";
HL10 - "Norm" indicator;
HL11 - "Failure" indicator;
S1 - front panel locking.

## Recommended connection diagram of motor-driven circuit breakers to ATSU



Q1, Q2, Q3, - automatic circuit breakers;
MP1, MP2, MP3 - motor drives for breakers Q1, Q2, Q3;
Q1.1, Q2.1 - contacts for blocking simultaneous switching on of input SDs;
Q1.2, Q2.2, Q3.2 - switching devices status control;
Q1.3, Q2.3, Q3.3 - control of emergency operation of circuit breakers; Q1.4, Q2.4, Q3.4 - "Removed" status contact;
KM9 - relays for switching the power supply of external control and signaling devices;
KM9.1, KM9.2 - contacts for blocking simultaneous connection to inputs; FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - indicator "Input 2 switching device on";
HL3 - indicator "Input 2 switching device off";
HL4 - indicator "Input 1 switching device removed";
HL5 - indicator "Input 1 switching device installed";'
HL6 - indicator "Input 1 switching device tripped automatically";

HL7 - indicator "Input 1 switching device in normal mode";
HL8 - indicator "Input 2 switching device on";
HL9 - indicator "Input 2 switching device off";
HL10 - indicator "Input 2 switching device removed";
HL11 - indicator "Input 2 switching device installed";
HL12 - indicator "Input 2 switching device tripped automatically";
HL13 - indicator "Input 2 switching device in normal mode";
HL14 - indicator "non-prriority switching device on";
HL15 - indicator "non-prriority switching device off";
HL16 - indicator "non-prriority switching device removed";
HL17 - indicator "non-prriority switching device installed";
HL18 - indicator "ATSU in auto mode";
HL19 - indicator "ATSU in manual mode";
HL20 - "Failure" indicator;
HL21 - "Norm" indicator;
S1 - front panel locking.

## Recommended connection diagram of electromagnetic-driven circuit breakers to ATSU



Q1, Q2, Q3, - automatic circuit breakers;
ЭМ1, ЭМ2, ЭМ3 - electromagnetic drives of breakers Q1, Q2, Q3;
Q1.1, Q2.1 - contacts for blocking simultaneous switching on of input SDs;
Q1.2, Q2.2, Q3.2 - switching devices status control;
Q1.3, Q2.3, Q3.3 - control of emergency operation of circuit breakers;
Q1.4, Q2.4, Q3.4 - "Removed" status contact;
S1 - front panel locking;
KM9 - relays for switching the power supply of external control and signaling devices;
KM9.1, KM9.2 - contacts for blocking simultaneous connection to inputs;
FU1 ... FU6 - fuses;
HL1 - signaling "non-priority load switching device on";
HL2 - indicator "Input 2 switching device on";
HL3 - indicator "Input 2 switching device off";
HL4 - indicator "Input 1 switching device removed";
HL5 - indicator "Input 1 switching device installed";
HL6 - indicator "Input 1 switching device tripped automatically";

HL7 - indicator "Input 1 switching device in normal mode";
HL8 - indicator "Input 2 switching device on";
HL9 - indicator "Input 2 switching device off';
HL10 - indicator "Input 2 switching device removed";
HL11 - indicator "Input 2 switching device installed";
HL12 - indicator "Input 2 switching device tripped automatically";
HL13 - indicator "Input 2 switching device in normal mode";
HL14 - indicator "non-prriority switching device on";
HL15 - indicator "non-prriority switching device off";
HL16 - indicator "non-prriority switching device removed";
HL17 - indicator "non-prriority switching device installed";
HL18 - indicator "ATSU in auto mode";
HL19 - indicator "ATSU in manual mode";
HL20 - "Failure" indicator;
HL21 - "Norm" indicator;
S1 - front panel locking.

## Overall and connection dimensions (mm)

ATSU design provides for its installation in the 1 to 6 mm thick mounting plate window or on a standard rail using the mounting parts included in the delivery.
Mounting on a TN35 rail in accordance with GOST R IEC 60715
Mounting in a window on a panel


## KEAZ switching equipment for the implementation of ready-made solutions

KEAZ offers a wide range of circuit breakers with both electromagnetic and motor drives for building ready-made ATS solutions:


The advantages of the circuit breaker ATS solution include the following:

- option of build a solution in a wide range of rated currents (16 to 4000 A);
- built-in overcurrent protection;
- no power consumption in the ON state.

KEAZ offers various series of contactors for building turnkey ATS solutions:


ПМЛ


OptiStart K


OptiDin MK

[^0]
[^0]:    ATS contactor systems offer number of advantages:
    $\square$ simple design;
    high switching speed, which is especially important when powering critical technological processes; lower financial costs for implementation in the range of currents up to 250A;
    reliability of contactors compared to motor and electromagnetic drives.

