Product Description

Tel.: 49 2162 40025
Fax: 49 2162 40035
info@dsl-electronic.de
www.dsl-electronic.de

DSL electronic® GmbH

Synchronization and Frequency / Voltage Control Unit SYFU50

for rapid and reliable synchronization, frequency and voltage tracking with reverse power protection

- **Frequency and voltage control for Motor potentiometers**
- **Automatic synchronizing for gas- and diesel units**
- **High-contrast LCD display**
- **LED-indication for "parallel"**
- **Automatic off-mains operation**
- **Frequency change for island-network during normal operation**
- **Customer friendly menu guide for parameter settings**
- **5 output changeover contacts**

Application

The SYFU50 synchronization and frequency / voltage control unit SYFU50 is used in generators for synchronization with the mains and for the parallel connection of generators. In addition to the synchronization function, it includes fully automatic static frequency and voltage control for the aggregate. Besides synchronization and frequency / voltage control, the up-to-date voltage and frequency values can be observed on the LCD. An LED on Frontpanel is used for optical checking of synchronizing. For **analog speed contro**l a unit (**SYFU50-G004**) with an analog output is available for output of difference frequency or output of rated value. The internal microcontroller includes a watchdog with automatic reset.
The settings of the synchronization and frequency / voltage control unit can be changed during operation via the easy-to-use menu in a dialog with the LCD display. Average values suggested by practical experience were selected as presets, and these can be at least be used as initial values for taking the unit into operation. Once the changed values have been saved via the "Mode" key, the unit works with the new parameters.

Function

The SYFU50 compares the mains voltage with the generator voltage with regard to voltage difference, voltage setpoint, frequency difference, frequency setpoint, running direction and phase position. Once all "synchronization conditions" have been assessed and fulfilled when the period zero points of both system voltages are approached, the synchronizing relay switches through while taking the switching delay time into account. In addition, constant program queries ensure that synchronizing pulses are not output unintentionally, even in unfavourable circumstances. With aid of an external 24VDC signal to INH-Input the synchronization can be disabled.
The SYFU50 contains changeover contacts for "Up" and "Down" adjustment for voltage and frequency control via which voltage and frequency of the generator are adjusted prior to synchronization. As the actual value approaches the setpoint, the adjustment pulse becomes successively smaller, thus preventing overshooting and the potentially uncontrollable oscillation which can occur as a result of immediate correction by the second relay and so on *ad infinitum*.
The "Low" or "High" pulses are usually fed to a motorized potentiometer which has a direct effect on the actuator and whose adjustment speed is adapted to the actuator there via adjusters. If the setting ranges of the motorized potentiometer are not enough, the regulating speed for voltage (TU trim) and frequency (TF trim) can additionally be changed. The clock rate "**Meßtakt**" (= number of actuating pulses / second) at which successive actuating pulses are output can be adapted according to the requirements. The preset values of the SYFU50 for frequency and voltage control are averages suggested by practical experience. Depending on the dynamics of the control loop, it could be necessary to reduce the clock rate in order to avoid control vibrations or to increase the clock rate in order to speed up the control process.
For voltage control during the synchronization process, the value used as a setpoint is the current mains voltage, to which the generator voltage is adjusted. In the case of mains failure (Umains < 25V = **off-mains operation**), the setpoint for the generator voltage is set automatically to Urated (for example 231/400 V) and for the frequency to rated value i.E. 50Hz. During off-main operation it may be necessary to change to 52Hz to switch off a paralleling photovoltaic source. This is done by setting and storing of Fnenn. After storing the generator will immediately running with the desired frequency. "Off-mains operation" is then shown on the LCD display.

For frequency control during the synchronization process, for the generator frequency a setpoint value of a half of difference frequency (F-Diff / 2) higher than the mains frequency is prescribed for the generator frequency. This makes a special “Up” acceleration function unnecessary as automatically are synchronized in the direction of the active power. At a differential frequency setting of for example 1.0 Hz (setpoint frequency = 50.5 Hz at 50 Hz mains), a synchronization pulse is triggered after a maximum of 2.0 seconds. When the auxiliary voltage is on, several generators can be synchronized in rapid succession using only one SYFU50 by switching over as necessary. In the case of mains failure (off-mains operation), the setpoint frequency for the generator is automatically adjusted to the rated frequency value (for example 50 Hz).

Technical Data

Type	Synchronization and Frequency/Voltage Control Unit SYFU50
Design	Plastic housing on 35 mm DIN bar according to DIN EN 50022 / DIN 46277
Housing material	ABS with fire protection equipment UL 94 V-0
Dimensions, weight	100 x 75 x 109.5 mm (WxHxD), approx. 0.6 kg
Auxiliary power supply	231 / 400V 50-60Hz, +/-10% in each case, approx. 2.5W, other values available, option: 24VDC
LED display refresh	Approx. 1 second
Program safety	Watchdog with automatic reset, failure of LCD display does not cause the functions to fail. Overall reset via simultaneous pressing of all 3 keys
Operating voltages	Generator- and Mains Voltages each 231V (L-N) / 400V (L-L) +/-10%, other values available
Tolerance of voltage displayed	0,5%
Operating frequency	45 – 65Hz, preset 50Hz
Tolerance of frequ. display	0,05%
Advance time	0-500 ms in steps of 10ms, preset 80ms (0.08s)
Pulse duration synchr. relay	200 ms (other values on request)
Synchr. direction	Synchronization with reverse power protection (Fgen > Fmains)
Mains failure detection	< 20 V, unit switches to off-mains operation, Ugen = Urated, Fgen = Frated (quarz-controlled)
Max. voltage difference	Between generator voltage and mains voltage, preset +/- 10V
Voltage deviation / rated	Max. deviation of generator voltage from rated value = 15% (for synchronization)
Min. frequency difference	Between generator and mains frequency, 0,07 Hz, setting locked (for synchronizing)
Max. frequency difference	Between generator and mains frequency , 0,1 – 1 Hz, preset = 0,5Hz (for synchronizing)
Frequency deviation / rated	Max. deviation of mains frequency from rated value = 2Hz (for synchronization)
Control pulses: frequency	Clock ratio approx. 50% for setpoint deviation of ½ * of frequency difference set Adjustable factor for duty ratio for frequency (preset to *1.0), for > 1 more switching time
Control pulses: voltage	Clock ratio approx. 50% for setpoint deviation of ½ * of voltage difference set Adjustable factor for duty ratio for voltage (preset to *1.0), for > 1 more switching time
Adjustment speed (Meßtakt)	Clock sequence for the control pulses (frequency and voltage) 0.2 – 2.5 seconds (preset 1.0 sec.)
INH-Input 16-17	Disableing of SY-function with external voltage 24VDC +/-20%
Detection of parallel circuit	At < 5 degrees, voltage and frequency control and synchronization pulse are no longer output
Analog Output	Mode 0: Output of difference frequency (Fgen-Fnet) 0,1V/Hz – 2V/Hz, Offset +/-5V, Max.range +/-10V
(SYFU50-G004)	Mode 1, 2: Output for speed control unit (Frated-Fact.) 0,1V/Hz-2V/Hz, Offset +/-5V, Max.range +/-10V
Contact rating	6A permanent, 250VAC, contact mat. AgSnO, altern. $10*10^6$, min. switching load 500mW, 12V, 10mA
Voltage insulation strength	4000V (coil-contact), 1000V (open contact)
Terminals	Strand 2.5 mm^2, rigid 4mm^2, torque 0.5Nm, screw size M3
Protection class	Housing IP40 (EN60529), terminals IP20
Environmental temperature	-10°C to +45°C, 95% humidity
Mains isolation acc. to	EN 60 742 (safety transformers)
General regulations	EN 50 178 (electrical resources in power installations)
Radio interference voltage	DIN EN 55011, Edition: 2003-08, Class B
Radio noise field intensity	DIN EN 55011, Edition: 2003-08, Class B
Noise immun. ESD (housing)	DIN EN 61000-4-2, Edition: 2001-12, Electrical dischargings, Performance criteria B
Noise imm. HF-field (hous.)	DIN EN 61000-4-3, VDE0847-4-3:2006 EMV, High frequency irradiation, Performance criteria A
Noise imm. BURST(AC pow.)	DIN EN 61000-4-4, Edition: 2005-07 EMV, Transient noise signals, Performance criteria B
Noise imm. BURST (cable)	DIN EN 61000-4-4, Edition: 2005-07 EMV, Transient noise signals, Performance criteria B
Noise imm. HF-field(AC pow.)	DIN EN 61000-4-6, Edition: 2001-12 EMV, High frequency inflow, Performance criteria A
Noise imm. HF-field (cable)	DIN EN 61000-4-6, Edition: 2001-12 EMV, High frequency inflow, Performance criteria A
Voltage dip AC power	DIN EN 61000-4-11, Edition: 2005-02 EMV, Voltage dip, Perform. criteria B (10-20ms) and C (500ms)
Short interruption AC power	DIN EN 61000-4-11, Edition: 2005-02 EMV, Short interruption 0-5 sec., Perform. Critera C
Self operating switching point	Acc. to DIN VDE 0126-1-1 together with corresponding switch-gear
Switching duration, maint.	100% ED, maintenance-free
Installation position	As required

Safety note: The unit must be installed and taken into operation by trained personnel only. It is of particular importance to observe the correct assignment of the mains and generator voltage terminals as well as VDE0160. Incorrect pole assignment can cause considerable damage to equipment and injury to persons.

Programming and Displaying of SYFU50

SYFU50 works normally at any time in its main function as synchronizing-, frequency- and voltage control unit, even though a service is reading or during changing the standard values on display menu. Only after saving of changed standard values the unit works with new settings. So you are able to change the settings during running system wthout problems.
Should only the **Standard Settings** be read, the **„Mode“**-Key must be push several time to get the different values on LCD-Display. In the following small table are the standard settings listed which can be changed from customer.
Remark: The settings can also be changed when only the auxiliary voltage (231V on terminals 2-3 or 400V on 2-4) be connected. Faillure announcements on LCD-display are to be ignored. After changing the settings a check of the settings with the „Mode“-key will be recommended.

Display Functions

With several times pushing of **„Mode“**-key following standard values will be shown on LCD-Display.

U-NennLN	**U-Diff**	**TU-Trimm**	**F-Nenn**	**F-Diff**	**TF-Trimm**	**T-Voreil**	**Messtakt**
Rated Voltage	Difference Voltage	Faktor for Puls Width	Nominal Frequency	Difference Frequency	Faktor for Pulse Width	Power Switch Delay	Control Time (Measure cycle)
231,0 V	**10,0V**	**1,00**	**50,00Hz**	**0,50Hz**	**1,00**	**0,08 s** (80ms)	**1,00 s**
Step accuracy of setting values:							
0,1V	**0,1V**	**0,01**	**0,01Hz**	**0,01Hz**	**0,01**	**0,01 s**	**0,2 s**
Maximum / Minimum setting values:							
600,0V	**20,0V**	**2,00**	**40-70Hz**	**1,00Hz**	**2,00**	**0,5 s**	**2,5 s**

During pushing down of **„Down“**-key the actual screen-function on LCD-Display will be hold, so the value can be showed over longer time without interruptions. For example:

Hz Gen V (Generatorfrequency and Voltage) **Hz Net V** (Mainsfrequency and Voltage)
50,5 231 changed all 2 Seconds to **50,0 231** , because not all values to be showed.

Another type of displaying with more accuracy (more digits after comma) be made with pushing of **„Up“**-key. Now the display shows the different values separately in a distance of 2 seconds. With pushing the Up-key now the display will be changed back to the first mode again.
For observation of synchronizing procedure at a distance the operator some times need an optical check which will be solved with LED on frontside. Flashing of LED shows that all conditions (voltage, frequency and others) to be fullfilled and that the point of synchronizing will be done short times later. From synchronizing moment on (contacts 36/37 be closing) the LED goes on steady lightning during parallel connecting. Also the LCD Display shows **“parallel”**. When the LED goes dark the synchronizing conditions are not fulfilled or there will be no paralleling connection.

When the unit is working on 400V System(L-L) instead on 231V (L-N) the connections for generator and mains must be changed and also the standard values to be changed. This must be done in the menüpoint **“U-Menü”** under **LN -> LL.** Here the value 0 or 1 can be choosen whereby 1 stands for L-L. Every time a switching back to L-N is possible. With switching L-N to L-L the Voltage “U-Diff” will not be changed automatically to a higher value. It must be done manually in setup-menu if necessary.

Programming of Settings

Preliminary Remark:
During programming inside the menu the choosing of the next menu follows the point on the lower line of LCD-display. That means, with Up or Down you set the choosen menupoint to the lower line and enter with „Mode“-key. Then maybe another branching are necessary. When the flashing values are achieved they have to be changed with Up or Down.
The keys have been holding pushed for appr. 1 second in any menu. This avoids changing of values by mistake.
During operating inside the menu the display changes back to normal display when no changing was made within 30 seconds.

Programming:
With „Mode“-key 2 x (at a time 1 Sec.) pushing until display **Service:** obtained. **Up**-key 2 x pushing, until value becomes 2 (=key-figure) and then enter with **Mode**-key. You are now reaching the main menu, with the menu points **U-Menue** (Voltage settings), **F-Menue (**Frequency settings), **SY-Menue** (Power switch delay) und **R-Menue** (control functions) with menupoints **Mode**, **Gain** and **Offset**.
Choosing of wanted menu point, enter with „Mode“ or branch into further menus until the choosen value is flashing.

Saving of settings:
The flashing value are to be changed with Up or Down keys. After setting of the new value enter with „Mode“ key, now menu changes to upper menu. Now you either you go back with **“Zurück”** (back) or branch into other points (You are allowed to change several values at a time)
At the end of settings you go back to **„Sichern“** (Save) or **„Abbruch“** (Break). With „Sichern“ standing on lower line the changed values to be save after entering with „Mode“-key (1 second). After this moment the unit works with the changed operating values. It is recommend to check the values in the displaying menu with the „Mode“-key.

Displaying of Events

After 1 x pushing of menu-key the display shows the last events with their lasting time in minutes. The display shows a 2-figured code for the type of event.

Following Display means **E: SY** Synchronizing (Closing)
T: 100 100 Minutes (Event 100 Minutes before)

Event code:
0: no Event **PA**: Parameter changed **SY**: Synchronizing

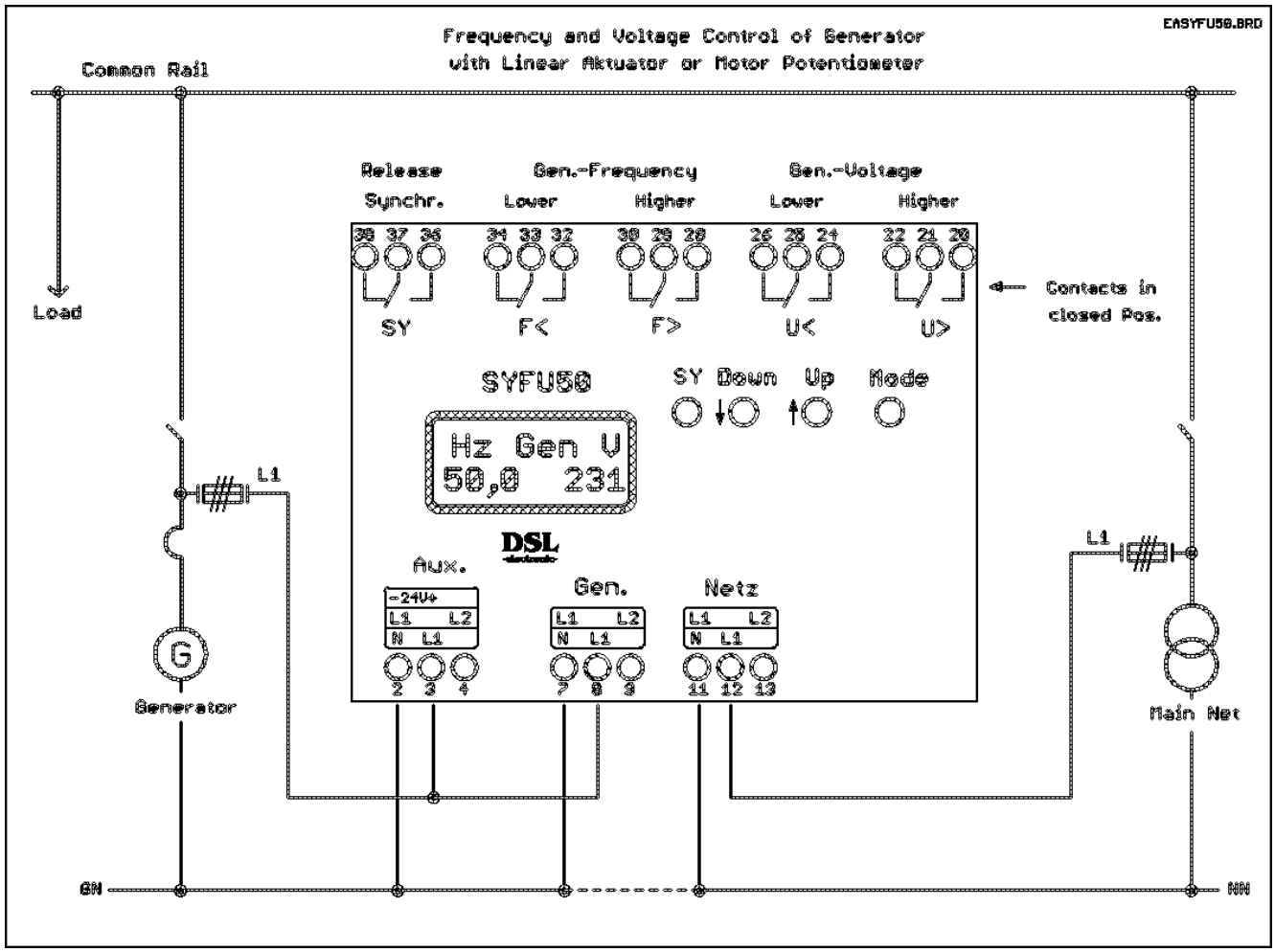
Analog output (SYFU50-G004)

Mode 0: Output of the frequency difference Fgen. – Fnet (ranges and values please look to technical data).
Mode 1: Output of the frequency difference Fcurrent – F rated related to the rated value. During beginning of syncronizing the rated frequency value is be set to +1/2 * Fdiff (setted difference frequency). During island running mode the rated frequency is equal to the nominal frequency F-Nenn.
Mode 2: Analog output like Mode 1 but without the functions of output relais for frequency control.

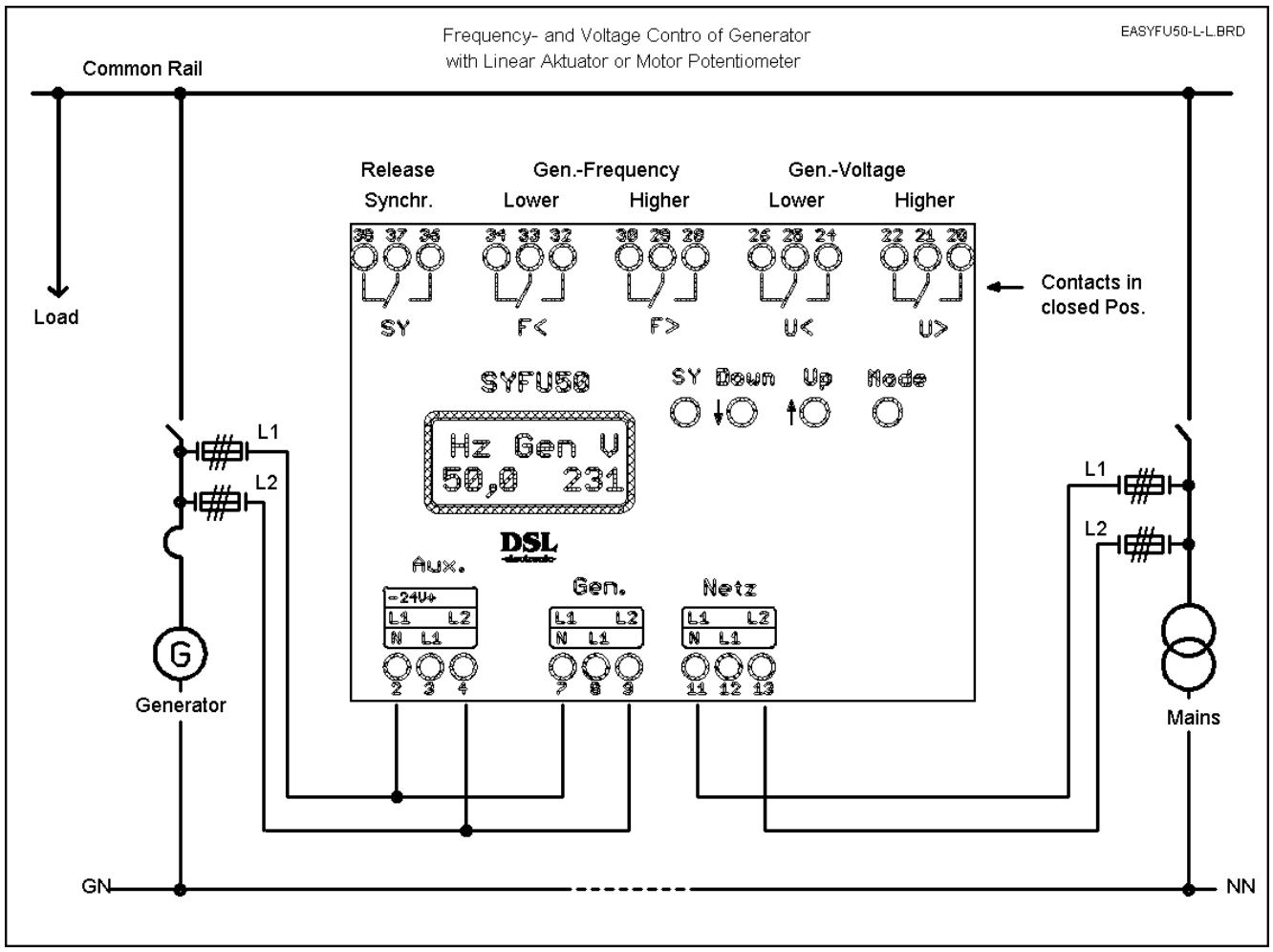
Other Funktions

With INH-Input 16-17 the synchronizing function can be suppressed by distancy on-switching a 24V DC voltage. All functions especially voltage and frequency control remain activ, only the syncronizing relay cuts off.
Should of any reason a failure arise (program crash) a **reset** is possible with pushing all 3 keys at a time. After reset the display shows short times “DSL-electronic” and the unit works immediately. A **full reset** is obtained with off and on switching of auxiliary voltage. A faillure only on display do not lead to faillures of controlling functions.

Circuit Diagram for L- N connection

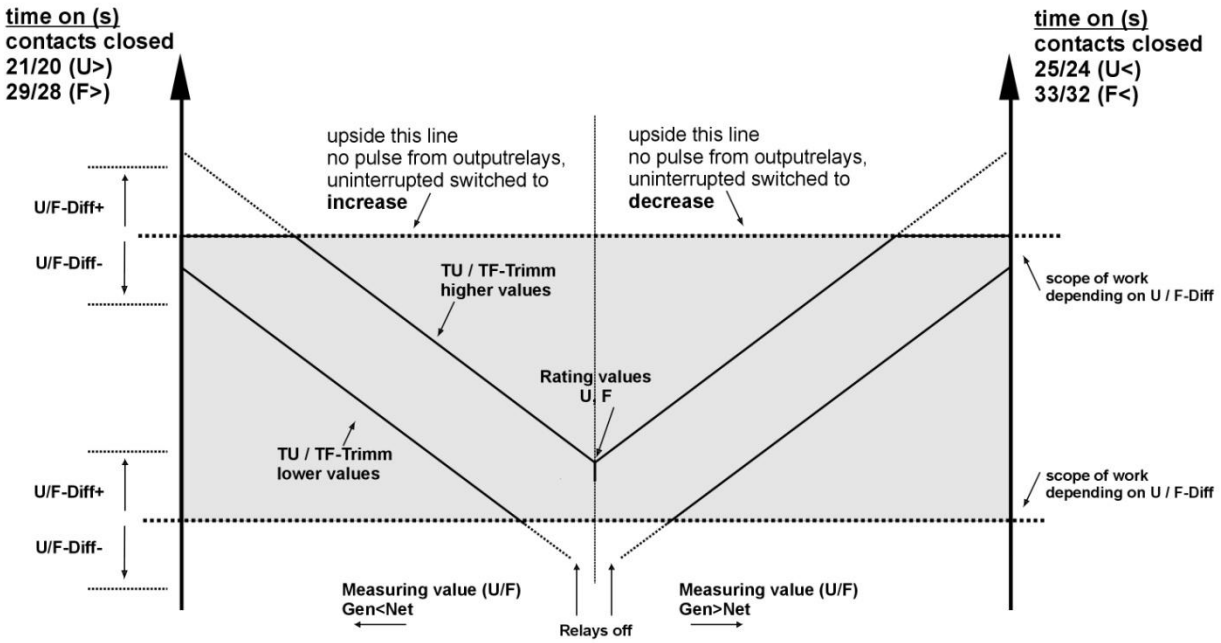


Circuit Diagram for L- L connection



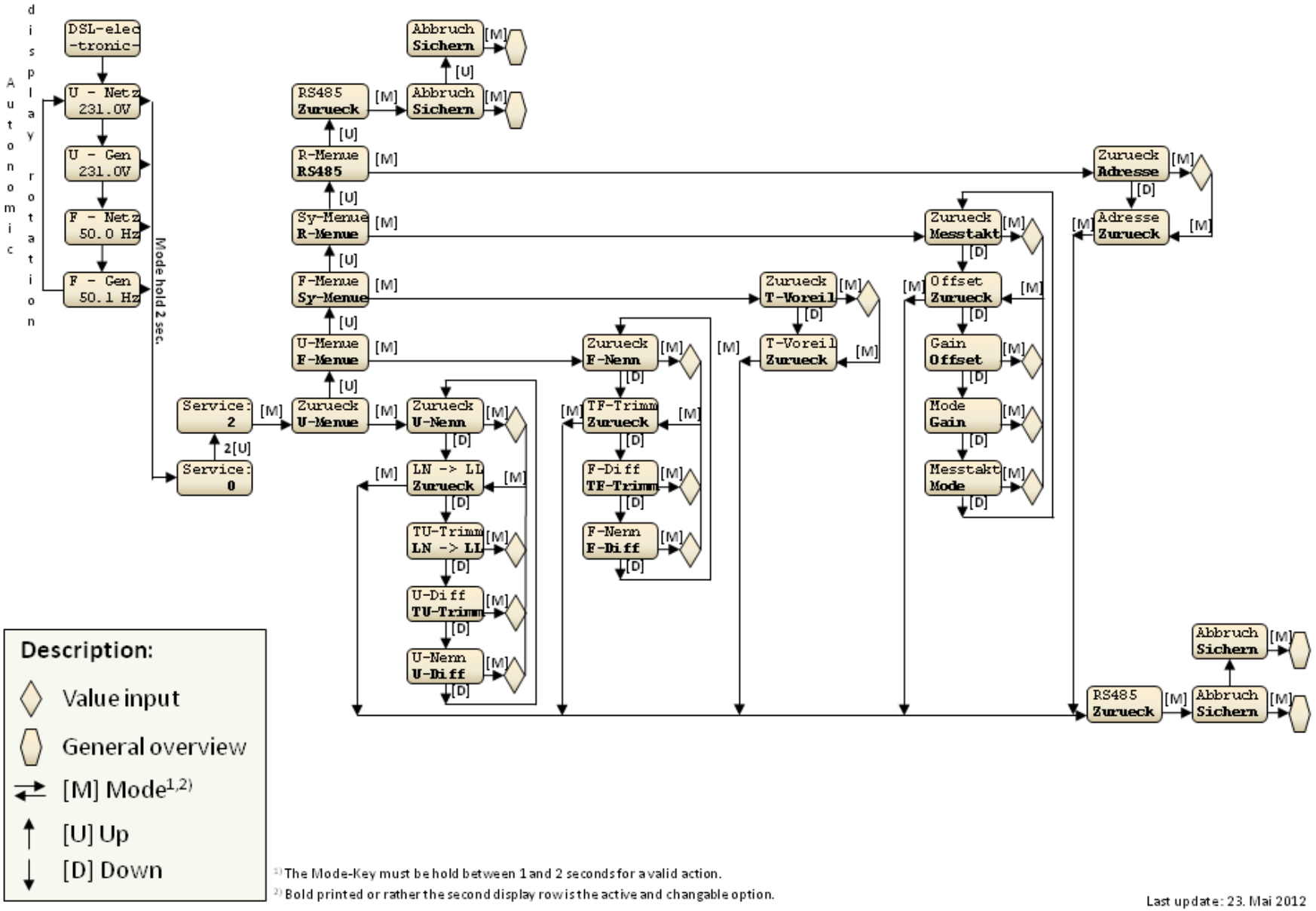
SYFU50

Regulation properties of outputrelays, important for U values and F values



To fit the regulation behavior to your AVR and Governor, please first choose the adequate value of U-Diff and F-Diff. Then please choose the adequate value of U-Trimm and F-Trimm.

SYFU50 Menu navigation



Description:

- Value input
- General overview
- [M] Mode[1,2)]
- [U] Up
- [D] Down

[1)] The Mode-Key must be hold between 1 and 2 seconds for a valid action.

[2)] Bold printed or rather the second display row is the active and changable option.

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