instruction manual

pump control system SEQU

versions:

operating terminal: **Sequ-BT**   software 027
power device: **Sequ-LT12V-300**   software 013

Inhaltsverzeichnis

Pump control system SEQU

abstract

The pump control system SEQU has been developed for driving different types of pumps. The rate of flow is adjustable. The device possesses connections for:
- flowmeter (turbine type or ultrasonic type)
- inputs for:
    - pick-up-switch: to pause / restart dosing activities
    - charge-start-signals: to start dosing a defined charge
    - filling level switch: to switch-off the dosing at empty tank
    - wheel-sensor: to start dosing only at driving
- outputs for:
    - transport: auxiliary output, switches in parallel to main pump
    - alarm: auxiliary output, switches in case of alarm-situation:
                              underfeeding
                              dry run

The rate of flow is measured with the flowmeter, the dosed amount is shown and recorded. Dependent on the operating mode it is possible to control the rate of flow (in litre per hour) or the amount (in litre).

The pump control system consists of an operating terminal SEQU-BT and one (or more) power devices SEQU-LT. The power devices are responsible for the pump-driving, therefore requiring different power devices for different types of pumps.

Currently we can offer the following power devices:
- SEQU-LT 12/050   driving of 12V/24V dc-pumps,
                      maximum output current: 6A
- SEQU-LT 12/150   driving of 12V/24V dc-pumps,
                      maximum output current: 12A
- SEQU-LT 12/300   driving of 12V/24V dc-pumps,
                      maximum output current: 16A/18A/25A
                      (depends on ordering)
- SEQU-LT 230   driving of 3~ ac-pumps,
                      output power depending on type: 250W / 500W / 750W
- SEQU-LT 230/switch driving of ac-loads:
                      230V~ ac-pumps, max. 10A
                      simple switching output, no flow rate control!!

Operating terminal Sequ-BT

brief description

The operating terminal SEQU BT has an menu-driven handling. All menu items and numerical entry are selected with four keys on the front side:
 escape / *minus* / *plus* / *enter*
Fault entry can always be corrected with escape, the SEQU-BT than will return to the main menu.

switch on / switch off

The *enter*-key also serves as on/off-switch:

one-time short push: device goes on
long pushing for more than 3 seconds: device shuts off

general handling

The plus / minus – keys are used to scroll between the different menu items. The actual selected menu item is always displayed as bold, double high text. This menu item is chosen with the enter-key.

Timeout
If no key is pressed for more than 30 seconds, the device will leave the current menu point and return to the first menu point in the main menu, ready to start dosing.
This serves as a emergency plan, if someone got stuck in between a deep submenu and is not sure, how to leave this submenu without undesired changes to the device parameter.

Menu item – main menu

The main menu consists of the following items:
dosing
charge dosing
show amounts
manual function
info
options

menu item – options menu

The options-menu is designated to change the behaviour of the device and to adapt the pump control system to every case of application.
back to main menu
choose flowmeter
calibrate flowmeter
language
choose units
I/O test
settings
alarm settings
control settings
factory setting
admin settings

main menu – dosing functions

The SEQU-BT has 3 types of different dosing-functions:
– normal dosing
– charge dosing
– manual function

normal dosing

In this mode of operation the user can provide a desired value for the rate of flow. This value can even be changed during the ongoing dosing.
During the dosing process:
– the transportrelais is permanently switched on
– the power for the pump will be regulated, to achieve the desired rate of flow
– the dosed amount is measured and summed up, and will be recorded as day-volume and as total value
– at activation of the pick-up-switch: the dosing will be paused
– the rate of flow will be monitored for:
  - underdosing
  - dry run
  with different alarm levels.
  In the event of underdosing the alarm-output will be switched on, but the dosing process will be continued.
  In the event of dry-run the alarm-output will be switched on and the dosing process will be stopped

With the underdosing-functionality it is possible to indicate a undersized pump-power, for instance as a result of to small spray nozzles. After reduction of the rate of flow set value it should be possible to continue to work.
By contrast the dry-run functionality can be used as an indicator for an empty storage tank. The work must be paused to refill the tank or change against a new, full tank.

charge dosing

In this mode of operation the user can provide a desired value for the rate of flow and the size of charge, which should be dosed. After start of the dosing process the device will dose the preset amount of dosing liquid. Afterwards the device is ready for the start of the next charge.
The charge-dosing can be manually started on the operating terminal
(menu item charge dosing → start batch → ENTER) or automatic started through the charge-start-input on the power device. As start-condition the device waits for an low → high signal change at the charge-start-input.

During the dosing process:
- the transportrelais is permanently switched on
- the power for the pump will be regulated, to achieve the desired rate of flow
- the dosed amount is measured and summed up, and will be recorded as day-volume and as total value
- the dosed amount is measured, after reaching the desired charge-size the device will stop dosing.
- at activation of the pick-up-switch: the dosing will be paused
- the rate of flow will be monitored for:
  - underdosing
  - dry run
  with different alarm levels. Both alarms work in the same way as above described.

manual function

The manual function works without the flowmeter and pick-up-inputs. The pump power is directly controlled from the user, in single steps between 0% and 100%.
During the dosing process:
- the transportrelais is permanently switched on
- the power for the pump can at any time adjusted (0%...100%)
- the flowmeter-impulses will be counted and displayed, so there is a limited chance to observe the dosing process and amount of dosed liquid
- the pick-up-switch is non-working
- the charge-start-switch is non-working
- both alarms (underdosing / dry run) are non working

show amounts

The dosed amount of liquid will be measured and summed up as daily amount and as total amount. Both values are stored in nonvolatile memory, they remain even at switched off device.
At menu item "**show amounts**" both values can be viewed and deleted. The erasure of the total volume is protected by a password.

info

This menu item displays some pages with actual device parameters. This is useful for fault diagnostics and remote maintenance.

info I: software version operating terminal / power device
info II: operation-hour counter
info III: selected flowmeter, flowmeter calibration value
info IV: adjustments for control loop and alarm-settings
info IX: manufacturer contact address

options

The last item in the main menu opens the way to the adjustment-submenu.

options – device adjustments

All adjustable device parameters can be changed in this menu and and its submenus. Caution must be taken, wrong changes can prevent the pump control system from properly working.

It is always a good idea to protocol (write down) the current state of all parameters before trying to change something. So it's possible to reissue the old values in the event of fault-inputs.

If the user unintentionally got stuck in some submenu and is afraid of more unintentionally parameter changes:

– wait 60 seconds without pushing a key
– all numerical entry and submenu-item have a 60s-timeout-limit, afterwards the operating terminal returns to the main menu
– no parameter will be changed/saved at this automatic return

back to main menu

This menu item returns the device into the start condition, to the first point of the main menu.

Additional it is possible to reach the main menu through multiple pushing of the "*ESCAPE*"-key. Every "*ESCAPE*"-push returns the device one menu-level.

choose flowmeter

Every single flowmeter together with the dosing-liquid has its own calibration value: per every liter dosed liquid the flowmeter delivers a precise number of impulses. This number is called the calibration value and is counted in impulses per liter liquid.

The operating terminal SEQU-BT is equipped with a memory for 10 different flowmeters. With the menu item "choose flowmeter" the user can pick one out of this 10.

All following dosing and calibration processes will work with this flowmeter and the corresponding calibration value.

calibrate flowmeter

The SEQU-BT comes with 10 different flowmeters and corresponding calibration values pre installed.
If this is not enough or the user wants rise the dosing precision, it is possible to change selectivle the parameters for every flowmeter.
The "calibrate flowmeter"-menu offers the following submenu-items:

– DFM nr.:
  In this place item the user can select, the parameters from which flowmeter number (1...10) he wants to change.
– name:
  For convenience every flowmeter-number can get a describing name. The name-string should not be longer than 10 characters. With the "*plus*"/"*minus*" - keys its possible to scroll through the alphabet, "*enter*" takes one character and "*ESCAPE*" aborts the whole name-input-sequence.
– Cal.value:
  If the user knows the calibration-value for a certain flowmeter- dosing-liquid combination already, he can input the calibration value (impulses per liter liquid) directly. The allowed number range is from 100 … 29999 impulses/liter
– calibrate flowmeter:
  the most accurate dosing results are achieved, if the flowmeter is manual calibrated:
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With this calibration procedure it is possible to obtain the correct calibration value even for unknown flowmeters. Therefore it is necessary to dose a precise amout of liquid. The SEQU-BT counts in the meantime all impulses from the flowmeter. At the end the user has to measure the dosed amount and input this number into the SEQU-BT. The device calculates the calibration value from this amount and from the (in the meantime) counted flowmeter-impulses.

Attention: please wait for at least 100 flowmeter-impulses, as otherwise the calculated calibration value is not very precise.

language

The operating terminal SEQU BT is capable of multilingual operation. This submenu allows the change of language for the user interface. Possible options are:

– german (preset)
– english
– more languages to come over time (depending on customer request)

choose units

Most dosing-tasks can be done with readings in liter per hour. But for especially small / large facilitys it may be useful to work with other units. As an alternative the SEQU-BT allows the user to display all readings in:

– liter per hour (preset version)
– liter per minute

– milliliter per hour

After the change all readings are displayed with the new choosen units.

Attention: This option is not yet installed. It is planned for devices delivered at 10/2017 and later.

input/output testing

At start-up of a new pump-system or at error searching it is very useful to view all device-inputs separately and also to test all device-outputs separately. This menu items serves for this task.

Every display-line shows one input or output with its actual state:
– pickup-input
– charge-start-input
– liquid-tank-empty input
– output transport relais / transport solenoid valve
– output alarm relais (push "**enter**" to toggle between output on/off)

If the external input on the power device are switched on/off, the displayed input-state should change between 0 ↔ 1.

The pickup-input is switched (i.e. the dosing will be paused), if the display shows a "1".

Is the polarity (0 / 1) not correct, the user can change the input polarity in the next menu item.

general settings

This submenu allows to change the following points in the device-behavior:

Menu item	Setting range	Factory value
Pickup-OFF-delay	0,0 …. 10,0 s	0,0s
Pickup-ON-delay	0,0 …. 10,0 s	0,0s
External alarm-output	flashing / static	flashing
Internal warning buzzer	On / Off	on
pickup-input	Opener / closer	closer
charge-start-input	Opener / closer	closer
Liquid-tank-empty input	Opener / closer	closer

– The pickup-signal can be delayed both at ON and OFF-signal. Compared to the pickup-signal the pump starts and stops the preset time later.
– The external alarm output is able to switch to on static or to flash 1 time per second.
– The internal warning buzzer honks in case of an alarm/failure. Some users find this distracting, so the buzzer can be turned off.
– All inputs can be declared as opener/closer, depending on the actual used external sensors and switches.
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alarm settings

The SEQU-BT is able to supervise the dosing process during the operation modes "normal dosing" and "charge dosing". The device recognizes:

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Error type	action
1) Underdose	- dosing continues to work - alarm output is switched (whether as a static output or as flashing output depends on the settings in the submenu "other settings" - see section above - display in the operating terminal is flashing and shows the "underdose" error text - typically this error occurs, if the pump power is not sufficient enough to reach the desired value for the rate of flow. The user can correct this error: he has to reduce the set point for the rate of flow, so the pump works with less counterpressure and quantity.
2) Dry run	- dosing process is stopped - alarm output is switched (whether as a static output or as flashing output depends on the settings in the submenu "other settings" - see section above - display in the operating terminal is flashing and shows the "dry-run" error text. This error message must be confirmed with ESCAPE/ENTER - typically this error occurs, if the liquid storage tank is empty. The stopped dosing process allows the refilling/changing of this tank. After that, the dosing process can start again.

It is possible to define error limits for both types of fault separately. For both errors exists a threshold for the rate of flow (as percentage from the adjusted reference value) and a waiting time. An error is triggered, if the actual rate of flow is during the whole waiting time lower than the threshold value.
The initial states at delivery are:

- – underdose: threshold: 50%
                        waiting time: 10s
- – dry run: threshold: 25%
                        waiting time: 20s

submenu control settings

The pump control system SEQU regulates the rate of flow during the dosing process. The goal is to achieve a constant rate of flow equal to the inserted set point.
Such control processes are almost always dependent from the detailed actual dosing system. Important are for instance the actual type of pump, length of tubes, type and technical data of used flowmeter, number and diameter of nozzles and so on.
Therefore it is possible to run in problems with the preset control parameters. Only in such cases one should consider to change this control settings, otherwise it is possible to change a good working system into a unusable one.
At a first step before changing values: write down the old values as a backup.

The following cases require a change in the control settings:
- control process to slow:
  The pump needs to much time to reach the desired value for the rate of flow:
  - increase the proportional value
  - increase the integral value
- control process to fast – rate of flow oscillates:
  The pump reaches no stable state, the rate of flow oscillates around the set point:
  - decrease the proportional value
  - decrease the integral value
- As a first guideline: try to increase/decrease the proportional/integral value both simultaneously with the same factor, for instance double both values / cut in half both values.

The following control values in dependency from the maximum rate of flow are working on most dosing systems:

Maximum expected rate of flow	Proportional value	Integral value
10 liter per hour	100	5
100 liter per hour	10	1
1000 liter per hour	2	1
initial states at delivery:	100	10

There are more control parameters, which can improve the dosing process. It is possible to change:

- displayfilter:
  This values allows a slow-down of the display of the actual rate of flow. This value does't influence the dosing process, only the readout. The higher the value, the more stable (but possibly also the more imprecise) is the readout.
  Initial state at delivery: 10%
- controlfilter:
  Especially at driving proportional solenoid valves or inhomogeneous working peristaltic pumps it is possibly to experience permanent oscillations of the rate of flow. This is undesirable, it is not good for the dosing process and it may be also not good for endurance of the dosing system. The control filter value allows a massive slow down of the regulation around the set point. The higher the value, the more stable is the system. The drawback is an increased inaccuracy.
  Initial state at delivery: 5%
- dosing start value:
  Many pumps will not work with very low voltages and start working only at (for instance) 20% pump power. For an increased dosing speed it is possibly to start the dosing process directly with this pump power starting value.

      Initial state at delivery: 25%

– dosing offset value:
some pumps will under no circumstances work at low voltages. For this types of pump it is possible to define this offset value. The output pump power will never go below this offset.
Initial state at delivery: 0%

BEWARE: The output voltage will never reach 0V, at misadjustment the pump may run (and dose) permanently. This can cause liquid flooding and more problems!

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factory settings

The operating terminal SEQU-BT is highly customizable. If the device has an unknown state, it is possible to reload the original factory settings.

BEWARE: all liquid amount measurements and flowmeter calibrations are lost. Make a backup of all needed values before, so you can reenter them.

administrator

The administrator-submenu is only designated for use through manufacturer and client service. As protection is it password protected. No user should change the parameters in this submenu.

Power device Sequ-LT12V/150W

specifications

Power supply Vcc   +12V … +24V
output current: dependent on the exact type of ordered device:
                                      +16A
                                      +20A
                                      +30A
                                      +40A

operating temperature: -25°C … +40°C

protection functions: reverse battery protection
                                      overtemperature protection
                                      output short circuit protection

dimensions: 240x160x115mm (with mounted heat sink)

mounting: 4x rubber buffer, with M4 internal thread

sensor inputs: pickup   (high-active, pnp-sensor)
                                      charge-start-sensor   (high-active, pnp-sensor)
                                      tank-empty-sensor   (high-active, pnp-sensor)
                                      1x reserve input (high-active, pnp-sensor)
                                      flowmeter 1   (low-active, npn-sensor)
                                      flowmeter 2 (reserved, not in use, low-active, npn-sensor)
                                      all inputs offer a +12V/30mA sensor-supply.

outputs: transport relais / solenoid valve: max. 1,5A
                                      alarm output   max. 1,5A
                                      both outputs connect the input-battery-voltage
                                      through to the output.

communication / handling: with SEQU BT

connection

All connection terminals in the power device are numbered from left to right:

terminal		description
X1 X2	battery plus + battery minus -	Battery for power supply, 12V … 24V
X3 X4	pump plus + pump minus -	Regulated pump/motor output
X5	Switching output 1 + -	Transport relais / solenoid valve
X6	Switching output 2 + -	Alarm output
X7	Switching input 1 +12V signal ground	Pickup - floating switch between +12V ↔ signal or electronic sensor with pnp-output
X8	Switching input 2 +12V signal ground	tank-empty signal - floating switch between +12V ↔ signal or electronic sensor with pnp-output - not used
X9	Switching input 3 +12V signal ground	Charge-start-signal - floating switch between +12V ↔ signal or electronic sensor with pnp-output
X10	Switching input 4 +12V signal ground	Charge-start-signal - floating switch between +12V ↔ signal or electronic sensor with pnp-output
X11	DFM1 +12V Signal Masse	DFM1 – flowmeter for dosed liquid (with npn-output) power supply plus for flowmeter impuls signal flowmeter ground flowmeter
X12	DFM2	DFM2 – reserve flowmeter
X30 X31		Communication to operating device SEQU-BT: either with multi-pin connector JP5 (direct at the top right of the device printed circuit board), cable with crimp-connector type Molex KK 22-01-2065 / KK 08-50-0032 - or manual connected at terminals X30/X31, pin assignment see at the following table and picture

Communication to the operating device SEQU-BT:
- – data transmission cable with twisted pairs,   3x2 pairs
- – maximal 50m length
- – suggested cable type: Lapp-Kabel Unitronic® Liyy Tp 3x2x0,2 (0035161)
- – wire description:

| Pin JP5	Terminal number (from left to right)	Beschreibung	Ader
1	X30-1	Power supply from power device to the operating device: $+U_{battery}$ to terminal	white
2	X30-2	Power supply from power device to the operating device: ground ($-U_{battery}$)	brown
3	X30-3	Onoff from operating device to the power device: high level turns on the power-device	green
4	X31-1	CAN communication: CANH	pink
5	X31-2	CAN communication: CANL	grey
6	X31-3	CAN communication: CAN - GND	yellow
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-			

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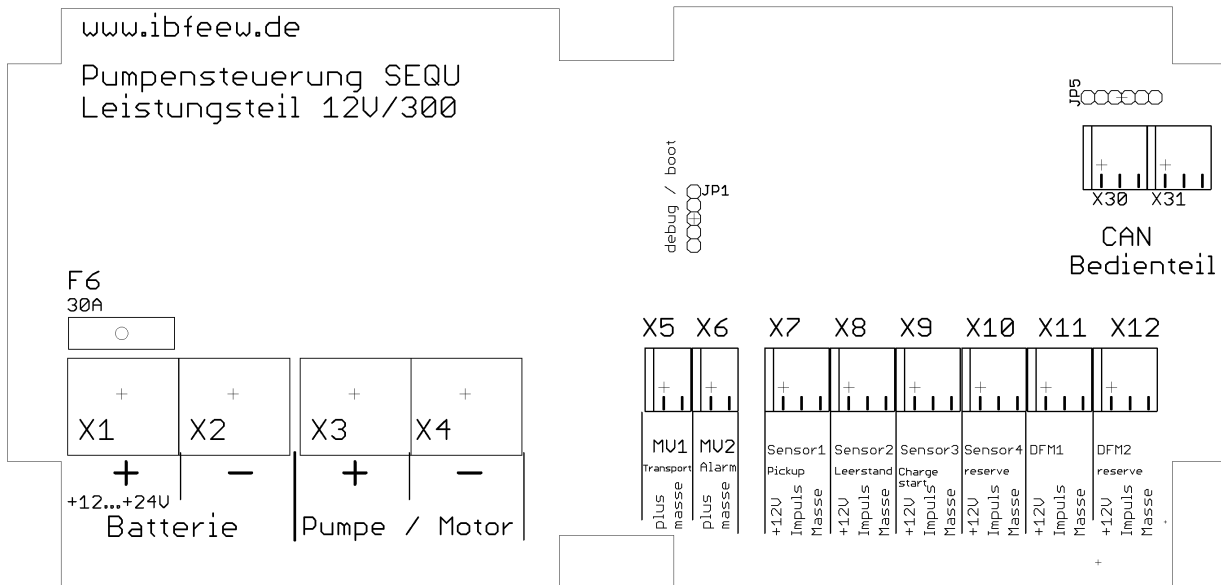
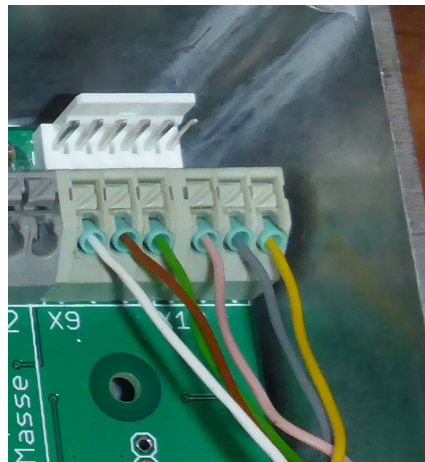Abbildung 1: SEQU-LT12/300: connection terminals

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Abbildung 2: connection of the communiaction-cable, using terminal X30/X31

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Complete pump system connection

connections