SIEMENS

Heating and D.h.w. Controller RVL481

Basic Documentation

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Contents

1 Summary

1.1 Brief description and key features

- The RVL481 is a multifunctional heating controller for use in residential and non-residential buildings that have their own d.h.w. heating facility
- Suited for:
  - Heating zone control with or without room influence via weather-compensated flow temperature control
  - Precontrol via demand-compensated control of the main / secondary flow temperature
  - Precontrol via demand-compensated boiler temperature control. Suited for integration into heat source cascades or heat generation systems (heat pump, solar, wood)
- For use in plants with own heat generation or with a district heat connection
- With regard to d.h.w. heating, the RVL481 is suited for plants with d.h.w. storage tanks, electric immersion heaters, solar d.h.w. heating and instantaneous systems with own heat exchangers
- The RVL481 has 29 plant types preprogrammed. When a certain type of plant is selected, all functions and settings required for that plant will be activated
- A scalable voltage output DC 0…10 V is used to pass the heat demand signal to other systems
- A multifunctional relay provides additional control functions, if required
- For direct adjustment of the heating curve, the well known “bar" is used. Digital adjustment of the heating curve is possible also. A setting knob is used for making room temperature readjustments
- All the other parameters are set digitally based on the operating line principle
- The RVL481 is capable of communicating with other units via LPB (Local Process Bus)
- Key design features: Operating voltage AC 230 V, CE conformity, overall dimensions to IEC 61554 (144 × 144 mm)

1.2 Equipment combinations

1.2.1 Suitable sensors

- For water temperatures:
  Suitable are all types of temperature sensors that use a sensing element LG-Ni 1000. The following types are presently available:
  - Strap-on temperature sensor QAD22
  - Immersion temperature sensors QAE212…
  - Immersion temperature sensor QAP21.3 complete with connecting cable
  - Immersion temperature sensor QAP21.2 complete with connecting cable, for solar use
- For the room temperature:
  Suitable are all types of temperature sensors that use a sensing element LG-Ni 1000:
  - Room temperature sensor QAA24
- For the outside temperature:
  - Outside sensor QAC22 (sensing element LG-Ni 1000)
  - Outside sensor QAC32 (sensing element NTC 575)

1.2.2 Suitable room units

- Room unit QAW50
- Room unit QAW70

1.2.3 Suitable actuators

All types of actuators from Siemens with the following features can be used:

- Electromotoric or electrohydraulic actuators with a running time of 0.5…14.5 minutes
- 3-position control
- Operating voltage AC 24… 230 V

1.2.4 Communication

Communication is possible with the following units:

- All LPB-compatible controllers supplied by Siemens
- SYNERGYR central unit OZW30 (software version 3.0 or higher)

Note

The heating controller RVL481 **cannot** be used as partner unit for the RVL469!

1.2.5 Passing on of heat demand signal

The scalable DC 0…10 V signal can be used to pass the heat demand signal to other devices in the system.

1.2.6 Product documentation

Document	*Doc. number*	*Stock number*
Data Sheet RVL481	N2541	–
Operating Instructions (all RVL types)*	B2540	74 319 0616 0
Installation Instructions, languages de, en, fr, nl, sv, fi, da, it, es	G2541	74 319 0618 0
CE Declaration of Conformity (all RVL types)	T2540	–
Environmental Declaration	E2541	–
Data Sheet QAW50	N1635	–
Data Sheet QAW70	N1637	–
Data Sheet LPB Basic System Data	N2030	–
Data Sheet LPB Basic Engineering Data	N2032	–

* unilingual, available in de, en, fr, nl, sv, fi, da, it, es

2 Use

2.1 Types of plant

The RVL481 is suitable for all types of heating plant that use weather-compensated flow temperature control. In addition, it can be used for demand-compensated control of the main flow.
With regard to d.h.w. heating, the RVL481 is suited for plants with storage tanks or d.h.w. heating via heat exchangers (instantaneous d.h.w. heating) or via solar collector.
Main applications:

- Heating zones and d.h.w. heating with own heat generation
- Heating zones and d.h.w. heating with a district heat connection
- Interconnected plants consisting of heat generation, several heating zones and central or decentral d.h.w. heating

2.2 Types of houses and buildings

Basically, the RVL481 is suited for use in all types of houses and buildings. It has been designed especially for:

- Multi-family houses
- Single-family homes
- Nonresidential buildings

2.3 Types of heating systems

The RVL481 is suited for use with all standard heating systems, such as:

- Radiators
- Convectors
- Underfloor heating systems
- Ceiling heating systems
- Radiant panels

2.4 Functions

The RVL481 is used if one or several of the following functions is / are required:

- Weather-compensated flow temperature control
- Flow temperature control via a modulating seat or slipper valve, **or** boiler temperature control through direct control of a single- or 2-stage burner
- D.h.w. storage tank charging through control of a mixing valve, charging pump or changeover valve, with or without circulating pump
- D.h.w. heating via heat exchanger (instantaneous d.h.w. heating), with or without circulating pump
- Optimum start / stop control according to the selected 7-day program
- Quick setback and boost heating according to the selected 7-day program
- ECO function: demand-dependent switching of the heating system based on the type of building construction and the outside temperature
- Voltage output DC 0…10 V for passing on the heat demand signal
- Multifunctional relay
- 7-day program for building occupancy with a maximum of 3 setback periods per day and daily varying occupancy schedules
- Own 7-day switching program for the release of d.h.w. heating
- Third 7-day switching program

- Input of 8 holiday periods per year
- Automatic summer- / wintertime changeover
- Display of parameters, actual values, operating state and error messages
- Communication with other units via LPB
- Remote operation via room unit and external switches
- Service functions
- Frost protection for the plant, the boiler and the house or building
- Minimum or maximum limitation of the return temperature
- DRT limitation
- Minimum and maximum limitation of the flow temperature
- Maximum limitation of the room temperature
- Periodic pump run
- Pump overrun
- Maximum limitation of the rate of setpoint increase
- Flow alarm
- Legionella function
- Manual d.h.w. charging

For the preprogrammed heating and d.h.w. heating circuits and their possible combinations, refer to section 3.2 ”Plant types”.

3 Fundamentals

3.1 Key technical features

The RVL481 offers 2 key technical features:

- The RVL481 has 6 heating circuit plant types and 5 d.h.w. plant types preprogrammed. When making use of all possible or practical combinations, there is a total of 29 plant types available
- All functions and their settings are combined in the form of function blocks

3.1.1 Plant types with regard to heating circuit

In terms of heating circuit, the following plant types are available:

- Heating circuit plant type 1 “Heating circuit control with mixing group”
- Heating circuit plant type 2 “Heating circuit control with boiler”
- Heating circuit plant type 3 “Heating circuit control with heat exchanger”
- Heating circuit plant type 4 “Precontrol with mixing group”
- Heating circuit plant type 5 “Precontrol with boiler”
- Heating circuit plant type 6 “Precontrol with heat exchanger”

Heating circuit plant type 5 is suited for integration into heat source cascades or heat generation systems.

3.1.2 Plant types with regard to d.h.w. heating

In terms of d.h.w., the following plant types are available:

- D.h.w. plant type 0 “No d.h.w. heating”
- D.h.w. plant type 1 “D.h.w. heating with charging pump”
- D.h.w. plant type 2 “D.h.w. heating with mixing group”
- D.h.w. plant type 3 “D.h.w. heating with changeover valve”
- D.h.w. plant type 4 “D.h.w. heating with heat exchanger”
- D.h.w. plant type 5 “D.h.w. heating with electric immersion heater “

The d.h.w. plant types 1, 2, 3 and 5 can be supported by solar systems, i.e. they allow for d.h.w. heating via solar collector.

3.1.3 Function blocks

The following function blocks are available:

- Function block “Enduser space heating”
- Function block “Enduser d.h.w.”
- Function block “Enduser general”
- Function block “Plant type”
- Function block “Cascade slave”
- Function block "Space heating"
- Function block “3-position actuator heating circuit”
- Function block “Boiler”
- Function block “Setpoint return temperature limitation”
- Function block “District heat”
- Function block "Maximum limitation of the return temperature d.h.w."
- Function block "Basic settings d.h.w."
- Function block "Release of d.h.w. heating"
- Function block "Priority and flow temperature setpoint d.h.w."
- Function block "D.h.w. storage tank"
- Function block "3-position actuator d.h.w."

- Function block “Derivative action time d.h.w. heating via heat exchanger”
- Function block “Multifunctional relay”
- Function block “Legionella function"
- Function block "Switching program 3"
- Function block “Service functions and general settings”
- Function block “Solar d.h.w. heating“
- Function block “Locking functions”

For each function block, the required settings are available in the form of operating lines. On the following pages, a description of the individual functions per block and line is given.

3.2 Plant types

The RVL481 has 29 plant types preprogrammed; the functions required for each type of plant are ready assigned. When commissioning the installation, the relevant plant type must be selected.
Each plant type consists of a heating circuit and a d.h.w. circuit. When making use of all possible or practical combinations, there is a total of 29 plant types available.

3.2.1 Selectable combinations

Combinations	*Type of heating circuit*	*Type of d.h.w. heating*
1–0	Heating circuit control with mixing group	No d.h.w.
1–1		Storage tank with charging pump
1–2		Storage tank with mixing group
1–4		Heat exchanger
1–5		With electric immersion heater
2–0	Heating circuit control with boiler	No d.h.w.
2–1		Storage tank with charging pump
2–2		Storage tank with mixing group
2–3		Storage tank with changeover valve
2–5		With electric immersion heater
3–0	Heating circuit control with heat exchanger	No d.h.w.
3–1		Storage tank with charging pump
3–2		Storage tank with mixing group
3–3		Storage tank with changeover valve
3–4		Heat exchanger
3–5		With electric immersion heater
4–0	Precontrol with mixing group	No d.h.w.
4–1		Storage tank with charging pump
4–2		Storage tank with mixing group
4–5		With electric immersion heater
5–0	Precontrol with boiler	No d.h.w.
5–1		Storage tank with charging pump
5–2		Storage tank with mixing group
5–4		Heat exchanger
5–5		With electric immersion heater
6–0	Precontrol with heat exchanger	No d.h.w.
6–1		Storage tank with charging pump
6–2		Storage tank with mixing group
6–5		With electric immersion heater

Notes on the plant diagrams with the different types of space heating and d.h.w. circuits are given in the following sections:

- Symbols ○ and □ indicate where and how the space heating circuit is connected to the d.h.w. circuit. where:
  ○ representing the flow
  □ representing the return
- The numbers beneath these symbols indicate the type of d.h.w. circuit with which the heating circuit can be combined

3.2.2 Heating circuit plant types

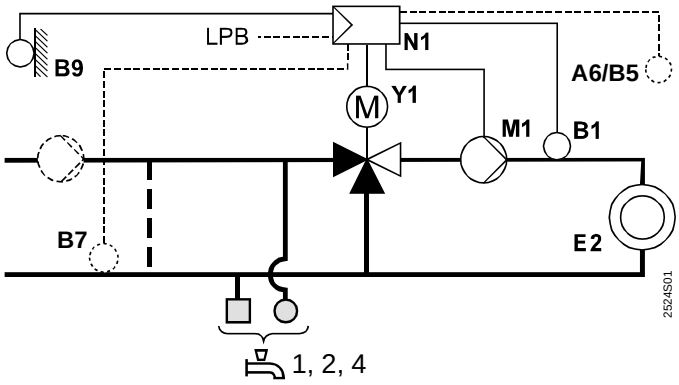
Heating circuit plant type 1

Heating circuit control with mixing group

Space heating with weather-compensated flow temperature control. 3-position control acting on the mixing valve of the heating zone.
Outside temperature signal from own sensor or data bus. With or without room influence. Heating up and setback according to the heating program.

Can be combined with d.h.w. types:

- with types 1, 2 and 4 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



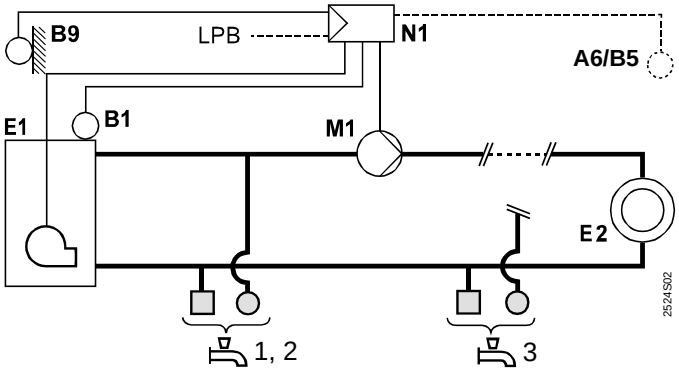
Heating circuit plant type 2

Heating circuit control with boiler

Space heating with own boiler, with weather-compensated boiler temperature control. 2-position control acting on the burner.
Outside temperature signal from own sensor or data bus. With or without room influence. Heating up and setback according to the heating program.

Can be combined with d.h.w. types:

- with types 1, 2 and 3 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



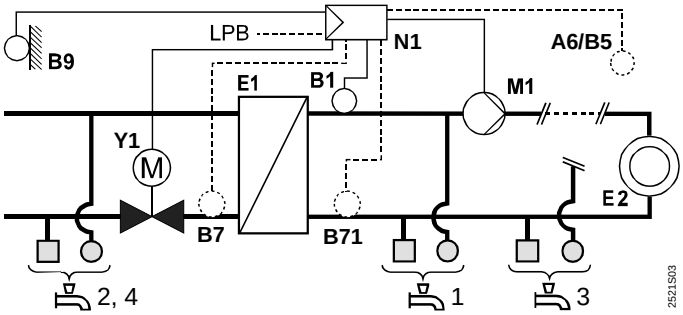
Heating circuit plant type 3

Heating circuit control with heat exchanger

Space heating with district heat connection, with weather-compensated flow temperature control acting on the valve in the primary return of the district heat connection. Outside temperature signal from own sensor or data bus. With or without room influence. Heating up and setback according to the heating program.

Can be combined with d.h.w. types:

- with types 2, 4 / type 1 / type 3 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



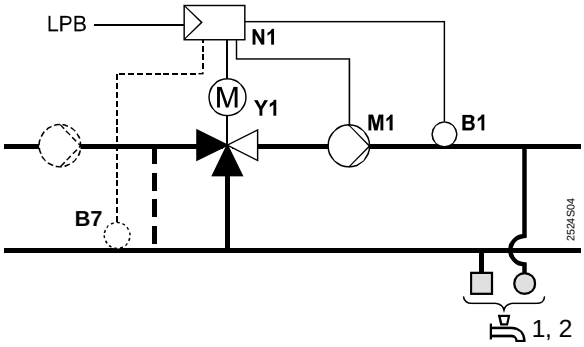
Heating circuit plant type 4

Precontrol with mixing group

Precontrol with demand-dependent control of the main flow temperature. 3-position control acting on the mixing valve in the main flow.
Heat demand signal from data bus. No heating program.

Can be combined with d.h.w. types:

- with types 1 and 2 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



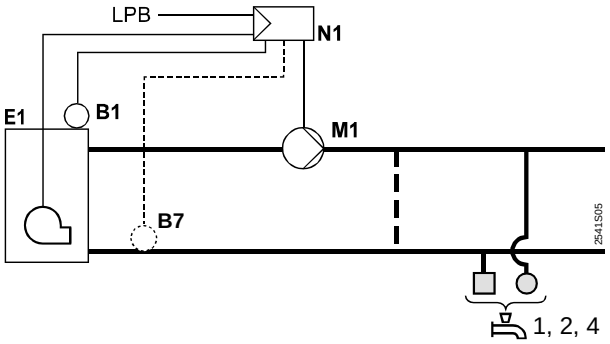
Heating circuit plant type 5

Precontrol with boiler control

Precontrol with demand-compensated control of the boiler temperature. 2-position control acting on the burner.
Heat demand signal from data bus. No heating program.

Can be combined with d.h.w. types:

- with types 1, 2 and 4 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



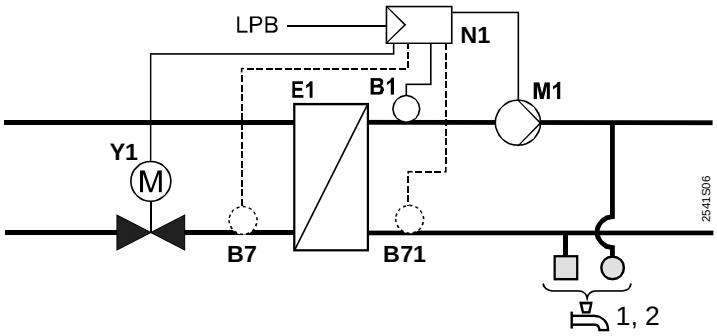
Heating circuit plant type 6

Precontrol with heat exchanger

Precontrol with district heat connection, with demand-compensated control of the secondary flow temperature acting on the valve in the primary return.
Heat demand signal from data bus. No heating program.

Can be combined with d.h.w. types:

- with types 1 and 2 via hydraulic connection at ○ and □
- with type 5 without hydraulic connection



3.2.3 D.h.w. plant types

Legend for sections 3.2.2 and 3.2.3:

A6	Room unit	E2	Consumer (space)
B1	Flow / boiler sensor	LPB	Data bus
B3	D.h.w. flow sensor	K6	Electric immersion heater
B31	Storage tank sensor / thermostat 1	M1	Heating circuit pump / circulating pump
B32	Storage tank sensor / thermostat 2	M3	Charging pump
B5	Room sensor	M4	Circulating pump
B6	Collector sensor	M5	Collector pump
B7	Return sensor (primary circuit)	N1	Controller RVL481
B71	Return sensor (secondary circuit)	Y1	Heating circuit mixing valve / 2-port valve
B9	Outside sensor	Y3	Changeover valve
E1	Heat source (boiler / heat converter)	Y7	D.h.w. mixing valve

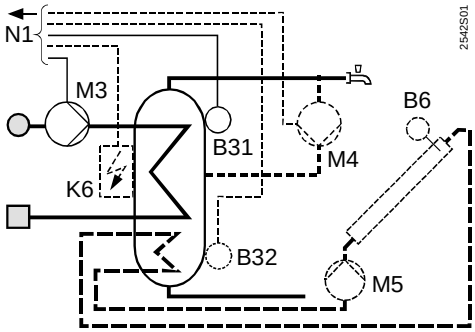
D.h.w. plant type 0

No d.h.w. heating.

D.h.w. plant type 1

D.h.w. heating with charging pump

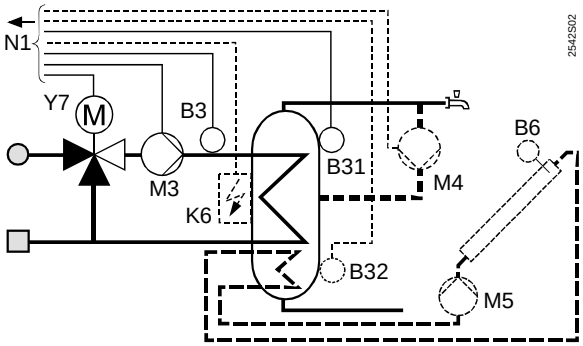
Charging of d.h.w. storage tank through control of the charging pump. Acquisition of the d.h.w. temperature with one or 2 sensors or thermostats. Circulating pump and solar collector or electric immersion heater are optional.



D.h.w. plant type 2

D.h.w. heating with mixing group

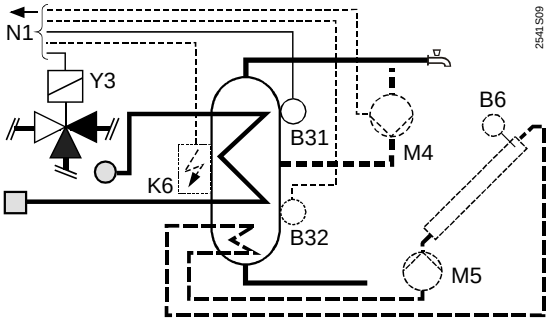
Charging of d.h.w. storage tank through control of the mixing valve according to own temperature sensor in the storage tank flow. Acquisition of the d.h.w. temperature with one or 2 sensors or thermostats. Circulating pump and solar collector or electric immersion heater are optional.



D.h.w. plant type 3

D.h.w. heating with changeover valve

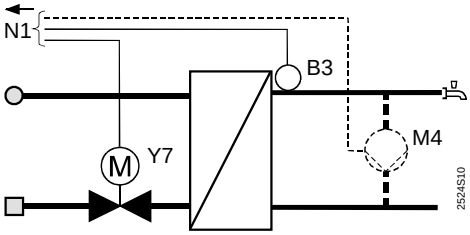
Charging of the d.h.w. storage tank through control of the changeover valve. Acquisition of the d.h.w. temperature with one or 2 sensors or thermostats. Circulating pump and solar collector or electric immersion heater are optional.



D.h.w. plant type 4

D.h.w. heating with heat exchanger

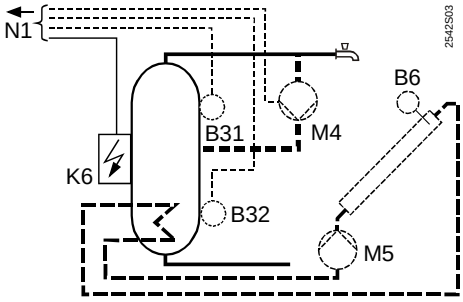
D.h.w. heating via heat exchanger (instantaneous d.h.w. heating) through control of the 2-port valve in the heat exchanger's primary return. Acquisition of the d.h.w. temperature in the heat exchanger's secondary flow. Circulating pump is optional, but strongly recommended.



D.h.w. plant type 5

D.h.w. heating with electric immersion heater

Charging of d.h.w. storage tank only through release of the electric immersion heater. No control of d.h.w. heating by the controller. Circulating pump and solar collector are optional.



3.3 Setting levels, function blocks and plant types

Level	Function block	Combination of plants																												
		1-0	1-1	1-2	1-4	1-5	2-0	2-1	2-2	2-3	2-5	3-0	3-1	3-2	3-3	3-4	3-5	4-0	4-1	4-2	4-5	5-0	5-1	5-2	5-4	5-5	6-0	6-1	6-2	6-5
Enduser	Enduser space heating	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●													
	Enduser d.h.w.		●	●	●			●	●	●			●	●	●	●			●	●			●	●	●			●	●	
	Enduser general	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Heating engineer	Plant type	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Cascade slave																					●	●	●	●	●				
	Space heating	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●													
	3-position actuator heating circuit	●	●	●	●	●						●	●	●	●	●	●	●	●	●	●						●	●	●	●
	Boiler						●	●	●	●	●											●	●	●	●	●				
	Setpoint limitation of return temperature	●	●	●	●	●						●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	District heating											●	●	●	●	●	●										●	●	●	●
	Max. limitation of d.h.w. return temperature												●		●													●	●	
	Basic settings d.h.w.		●	●	●	●		●	●	●	●		●	●	●	●	●		●	●	●		●	●	●	●		●	●	●
	Release of d.h.w. charging		●	●	●			●	●	●			●	●	●	●			●	●			●	●	●			●	●	
	D.h.w. priority and flow temperature setpoint		●	●	●			●	●				●	●		●			●	●			●	●	●			●	●	
	D.h.w. storage tank		●	●		●		●	●	●	●		●	●	●		●		●	●	●		●	●		●		●	●	●
	3-position d.h.w. actuator			●	●				●					●		●				●				●	●				●	
	Derivative action time d.h.w.heating via heat exchanger				●											●									●					
	Multifunctional relay	●	●	●	●		●	●	●	●		●	●	●	●	●		●	●	●		●	●	●	●		●	●	●	
	Legionella function		●	●				●	●	●			●	●	●				●	●			●	●				●	●	
	Time switch program 3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Service functions and general settings	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Solar d.h.w. heating		●	●		●		●	●	●	●		●	●	●		●		●	●	●		●	●		●		●	●	●
Locking level	Locking functions	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

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The above table shows
- the assignment of function blocks to the 3 operating levels
- the function blocks activated with the different plant types

3.4 Heating circuit operating modes

The heating circuit operating mode is selected on the controller by pressing the respective button. Also, the operating mode can be changed by bridging terminals H1–M.

3.4.1 Automatic operation

Auto

- Automatic changeover from NORMAL to REDUCED temperature, and vice versa, according to the 7-day program entered
- Automatic changeover to holiday mode, and back, according to the holiday schedule entered
- Demand-dependent switching of the heating system according to the room and outside temperature while giving consideration to the building's thermal inertia (ECO function)
- Remote operation via room unit (optional)
- Frost protection is ensured

3.4.2 Continuously REDUCED heating

- Continuous heating to the REDUCED temperature
- With ECO function
- No holiday mode
- Remote operation from a room unit not possible
- Frost protection is ensured

3.4.3 Continuously NORMAL heating

- Continuous heating to NORMAL temperature
- No ECO function
- No holiday mode
- Remote operation via room unit not possible
- Frost protection is ensured

3.4.4 Protection mode

- Heating is switched off, but is ready to operate
- Frost protection is ensured

3.5 D.h.w. operating mode

D.h.w. heating is switched on and off by pressing the respective button:

- ON (button is lit): D.h.w. heating takes place independent of the heating circuit's operating mode and control. D.h.w. heating to the NORMAL or REDUCED setpoint can be provided as follows:
  - According to the entered switching program 2
  - According to the entered heating circuit program (–1 h)
  - Continuously (24 hours a day)

  During the entered holiday period, d.h.w. heating and the circulating pump are deactivated when using controllers with no bus connection (with data bus, depending on the setting made).
- OFF (button dark): No d.h.w. heating. Frost protection is ensured (with the exception of plant types x–4 and x–5)

3.6 Manual operation

The RVL481 can be switched to manual operation. In this case, the control will be switched off. In manual operation, the various actuating devices behave as follows:

- Heating circuit mixing valve: This mixing valve is not under voltage, but can be manually driven to any position by pressing the manual buttons /▼ (close) and /▲(open). The heating circuit pump / circulating pump is continuously running.
- Boiler: The 2 burner stages are continuously on. The manual button /▼ can be used to switch the second stage on and off. Pump M1 is continuously running
- Charging pump: The charging pump is continuously running
- Collector pump: The collector pump is continuously running
- Changeover valve: The changeover valve is always in the ”Heating circuit” position
- D.h.w. slipper / seat valve: This valve is driven to the fully closed position, in which case the closing time is five times the set running time. Then, it is deactivated
- Circulating pump M4: Continuously running
- Electric immersion heater K6: Continuously released
- Multifunctional relay: Continuously energized

Manual operation also negates any overriding of the controller's operating mode (bridging of H1–M).

3.7 Plant type and operating mode

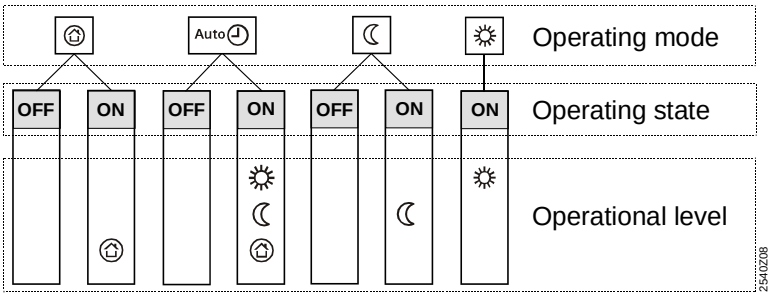
Depending on the selected type of plant, the following operating modes are available:

Plant type	Auto					
1–0	YES	YES	YES	YES	NO	YES
1–1, 1–2, 1–4, 1–5	YES	YES	YES	YES	YES	YES
2–0	YES	YES	YES	YES	NO	YES
2–1, 2–2, 2–3, 2–5	YES	YES	YES	YES	YES	YES
3–0	YES	YES	YES	YES	NO	YES
3–1, 3–2, 3–3, 3–4, 3–5	YES	YES	YES	YES	YES	YES
4–0	YES	NO	NO	NO	NO	YES
4–1, 4–2, 4–5	YES	NO	NO	NO	YES	YES
5–0	YES	NO	NO	*	NO	YES
5–1, 5–2, 5–4, 5–5	YES	NO	NO	*	YES	YES
6–0	YES	NO	NO	NO	NO	YES
6–1, 6–2, 6–5	YES	NO	NO	NO	YES	YES

* Depending on the boiler's operating mode:
– Boiler with automatic shutdown: NO
– Boiler with manual shutdown: YES

3.8 Operating state and operational level

The user selects the required heating circuit operating mode by pressing the respective button. Each operating state has a maximum of 2 operating states – with the exception of operating mode "Continuously NORMAL heating" (only one operating state possible).
When the ECO function is active, and in the case of quick setback, the operating state is always OFF.
When the operating state is ON, there is a maximum of 3 operational levels, depending on the operating mode. The operational level is determined by the heating program and the holiday program.



4 Acquisition of measured values

4.1 Room temperature (A6, B5)

4.1.1 Measurement

The following choices exist:

- A room temperature sensor QAA24 can be connected to terminal B5
- A room unit QAW50 or QAW70 can be connected to terminal A6
- 2 units can be connected to the terminals. In this case, the RVL481 can ascertain the average of the 2 measurements. The other room unit functions will not be affected by averaging

4.1.2 Handling faults

If there is a short-circuit or open-circuit in one of the 2 measuring circuits, the control responds as follows, depending on the room temperature source (setting on operating line 65):

- No sensor (operating line 65 = 0):
  A short-circuit or open-circuit has no impact on the control. An error message will not be generated
- Room unit sensor QAW… (operating line 65 = 1):
  In the event of a short-circuit or open-circuit, the control continues to operate with the room model, depending on the function. An error message will be generated
- Room temperature sensor QAA24 (operating line 65 = 2):
  In the event of a short-circuit or open-circuit, the control continues to operate with the room model, depending on the function. An error message will be generated
- Average value (operating line 65 = 3):
  In the event of a short-circuit or open-circuit in one of the 2 measuring circuits, the control continues to operate with the normally working measuring circuit. An error message will be generated.
  In the case of a short-circuit or open-circuit in both measuring circuits, the control continues to operate with the room model, depending on the function. 2 error messages will be generated
- Automatic mode (operating line 65 = A):
  Since the controller itself decides how it acquires the room temperature, error messages cannot be generated.

4.1.3 Room model

The RVL481 features a room model. It simulates the progression of the room temperature. In plants with no measurement of the room temperature, it can provide certain room functions (e.g. quick setback).
For more detailed information, refer to section 0 "
Room model temperature".

4.2 Flow and boiler temperature (B1)

4.2.1 Measurement

The flow or boiler temperature is acquired with one LG-Ni 1000 sensor.
Averaging with 2 sensors is not possible.

4.2.2 Handling faults

A short-circuit or open-circuit in the measuring circuit is identified and indicated as a fault. In that case, the plant responds as follows:

- Plants with 3-position control:
  Heating circuit pump / circulating pump M1 continues to run and the mixing valve will close
- Plants with 2-position control:
  The heating circuit pump / circulating pump M1 continues to run and the burner will shut down

4.3 Outside temperature (B9)

4.3.1 Measurement

The outside temperature is acquired with the outside sensor. This can be a QAC22 or QAC32:

- QAC22: Sensing element LG-Ni 1000
- QAC32: Sensing element NTC 575

The controller automatically identifies the type of sensor used.
In interconnected plants, the outside temperature signal is made available via LPB. Controllers having their own sensor pass the outside temperature signal to the data bus.

4.3.2 Handling faults

If there is a short-circuit or open-circuit in the measuring circuit, the controller responds as follows, depending on the outside temperature source:

- Controller not connected to the data bus (LPB):
  The control operates with a fixed value of 0 °C outside temperature. An error message will be generated
- Controller connected to the data bus (LPB):
  If the outside temperature is available via data bus, it will be used. An error message will not be generated (this is the normal state in interconnected plants!). If there is no outside temperature available on the data bus, however, the control uses a fixed value of 0 °C outside temperature. In that case, an error message will be generated.

4.4 Primary return temperature (B7)

4.4.1 Measurement

The primary return temperature is acquired with a sensor having a sensing element LG-Ni 1000. This measured value is required for minimum and maximum limitation of the primary return temperature and for limitation of the temperature differential (DRT limitation).
In interconnected plants, the primary return temperature with plant type 1–x can be acquired via data bus. Controllers with plant type 1–0 and connected sensor pass the return temperature signal to the data bus.

4.4.2 Handling faults

If there is a short-circuit or open-circuit in the measuring circuit, and if the controller requires the return temperature, it responds as follows:

- If there is a return temperature from a controller of the same segment available on the data bus, it is used (only with plant type 1–x). No error message will be generated since this is the normal state in interconnected plants
- However, if there is no return temperature available on the data bus, the return temperature limitation functions will be deactivated and an error message generated

4.5 Secondary return temperature (B71)

4.5.1 Measurement

The secondary return temperature is acquired with a sensor having a sensing element LG-Ni 1000. This measured value is required for DRT limitation (plant types 3–x and 6–x), together with the primary return temperature.

4.5.2 Handling faults

If there is a short-circuit or open-circuit in the measuring circuit, and if the controller requires the return temperature, DRT limitation will be deactivated. An error message will be generated

4.6 D.h.w. flow temperature (B3)

4.6.1 Measurement

The d.h.w. flow temperature is acquired with a sensor having a sensing element LG-Ni 1000.

4.6.2 Handling faults

If there is a short-circuit or open-circuit in the measuring circuit, the d.h.w. will no longer be heated. The charging pump is deactivated and the actuating device (slipper or seat valve) is shut.
An error message will be generated.

4.7 D.h.w. storage tank temperature (B31, B32)

4.7.1 Measurement

The storage tank temperature can be acquired as follows:

- With one or 2 sensors having a sensing element LG-Ni 1000, or
- With one or 2 thermostats

This means that there are 2 measuring circuits.

4.7.2 Handling faults

The controller's response to faults in the measuring circuits depends on the type of d.h.w. demand (setting on operating line 126):

- One d.h.w. storage tank temperature sensor (operating line 126 = 0 or 4):
  In the event of a short-circuit or open-circuit in one of the 2 measuring circuits, the controller continues to work with the other measuring circuit, if possible. An error message will not be generated.
  If no valid measured value is obtained from either of the measuring circuits, an error message will be generated. The d.h.w. will no longer be heated and the charging pump and the collector pump are deactivated.
  Exception: With plant type x–2, the d.h.w. storage tank is always charged when sensor B3 (d.h.w. flow) works normally
- 2 d.h.w. storage tank temperature sensors (operating line 126 = 1 or 5):
  In the event of a short-circuit or open-circuit in one of the 2 measuring circuits, the controller continues to work with the other measuring circuit. An error message will be generated.
  If no valid measured value is obtained from either of the measuring circuits, 2 error messages will be generated. The d.h.w. will no longer be heated and the charging pump and the collector pump are deactivated.
  Exception: With plant type x–2, the d.h.w. storage tank is always charged when sensor B3 (d.h.w. flow) works normally
- One d.h.w. storage tank thermostat (operating line 126 = 2):
  If, in measuring circuit B31, there is neither an open-circuit (thermostat open) nor a short-circuit (thermostat closed), an error message will be generated. The d.h.w. will no longer be heated and the charging pump is deactivated.
  Exception: With plant type x–2, the d.h.w. storage tank is always charged when sensor B3 (d.h.w. flow) works normally
- 2 d.h.w. storage tank thermostats (operating line 126 = 3):
  If, in the measuring circuits, there is neither an open-circuit (thermostat open) nor a short-circuit (thermostat closed), an error message will be generated. The controller will continue to work with the measuring circuit that operates correctly.
  If, in both measuring circuits, there is neither an open-circuit (thermostat open) nor a short-circuit (thermostat closed), 2 error messages will be generated. The d.h.w. will no longer be heated and the charging pump is deactivated.
  Exception: With plant type x–2, the d.h.w. storage tank is always charged when sensor B3 (d.h.w. flow) works normally

4.8 Collector temperature (B6)

4.8.1 Measurement

The collector temperature is acquired via a sensor with sensing element LG-Ni 1000 and an extended measuring range.

4.8.2 Handling faults

An error message is generated and the collector pump deactivated with a delay of 12 hours in case of a short-circuit or open-circuit in the measuring circuit.
There is no solar d.h.w. heating.

5 Function block "Enduser space heating"

This function block contains settings that the enduser himself can make.

5.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
1	Setpoint of NORMAL heating	20.0 (0…35)	°C
2	Setpoint of REDUCED heating	14.0 (0…35)	°C
3	Setpoint of holiday mode / frost protection	10.0 (0…35)	°C
4	Weekday for the heating program	1-7 (1…7 / 1-7)	
5	First heating period, start of NORMAL heating	06:00 (00:00…24:00)	hh:mm
6	First heating period, start of REDUCED heating	22:00 (00:00…24:00)	hh:mm
7	Second heating period, start of NORMAL heating	--:-- (00:00…24:00)	hh:mm
8	Second heating period, start of REDUCED heating	--:-- (00:00…24:00)	hh:mm
9	Third heating period, start of NORMAL heating	--:-- (00:00…24:00)	hh:mm
10	Third heating period, start of REDUCED heating	--:-- (00:00…24:00)	hh:mm
11	Holiday period	- (1…8)	
12	Date of first day of holiday	--.-- (01.01…31.12)	dd:MM
13	Date of last day of holiday	--.-- (01.01…31.12)	dd:MM
14	Heating curve, flow temperature setpoint at an outside temperature of 15 °C	30 (20…70)	°C
15	Heating curve, flow temperature setpoint at an outside temperature of –5 °C	60 (20…120)	°C

5.2 Setpoints

5.2.1 General

The setpoints of the NORMAL and the REDUCED room temperature and of frost protection for the plant / holiday mode are entered directly in °C room temperature. They are independent of whether or not the control uses a room temperature sensor.

5.2.2 Frost protection for the building

The lowest valid room temperature setpoint always corresponds to at least the setpoint of holiday mode / frost protection (setting on operating line 3), even if lower values have been entered as the setpoints of the NORMAL and the REDUCED room temperature (settings on operating lines 1 and 2).
If a room sensor is used and the room temperature falls below the holiday / frost protection setpoint, ECO – if available – will stop OFF until the room temperature has risen 1 °C above the holiday / frost protection setpoint.

5.3 Heating program

The heating program of the RVL481 provides a maximum of 3 heating periods per day; also, every weekday may have different heating periods.

Caution

The entries to be made are not the switching times, but the periods of time during which the NORMAL room temperature shall apply. Usually, these periods of time are identical to the building's occupancy times. The actual switching times for the change from the REDUCED to the NORMAL room temperature, and vice versa, are calculated by the optimization function. (Precondition: Optimization is activated).
Using the setting "1-7" on operating line 4, it is possible to enter a heating program that applies to all weekdays. This simplifies the settings: If the weekend times differ, enter the times for the entire week first, and then change days 6 and 7 as required.
The settings are sorted and overlapping heating periods combined.

5.4 Holiday program

A maximum of 8 holiday periods per year can be programmed. At 00:00 of the first day of the holiday period, changeover to the setpoint for frost protection / holiday mode takes place. At 24:00 of the last day of the holiday period, the RVL481 will change to NORMAL or REDUCED heating in accordance with the time switch settings.
The settings of each holiday period will be cleared as soon as the respective period has elapsed.
Holiday periods may overlap. It is not necessary to observe a certain order. Depending on the entry made on operating line 121, the holiday function will switch off d.h.w. heating and the circulating pump.
The holiday program is only active in AUTO mode.

6 Function block "Enduser d.h.w."

This function block contains settings for d.h.w. heating that the enduser himself can make.

6.1 Operating lines

Line	*Function, parameter*	*Factory setting (Range)*	*Unit*
26	Setpoint of NORMAL d.h.w. temperature	55 (20…100)	°C
27	D.h.w. temperature	Display function	
28	Setpoint of REDUCED d.h.w. temperature	40 (8…80)	°C

6.2 Setpoint

The NORMAL and REDUCED d.h.w. temperature setpoints are to be entered in °C. When using thermostats, it must be made certain that the NORMAL setpoint entered here agrees with the setpoint of the thermostat or – if 2 thermostats are used – of both thermostats. If there is a deviation, the charging temperature cannot be correctly calculated (charging temperature = NORMAL setpoint [operating line 26] + boost of charging temperature [operating line 127]).
If d.h.w. heating is switched to the electric immersion heater, the setpoint adjustment is inactive in that case, since the thermostat of the electric immersion heater will ensure temperature control of the storage tank.

6.3 Actual value

The d.h.w. temperature is displayed in °C as follows, depending on the type of plant:

Plant type	*Display*
x–1, x–2, x–3	B31 or maximum selection of the 2 storage tank sensors B31 and B32
x–4	D.h.w. flow temperature sensor B3

If the measurement is made with one or 2 thermostats, it is not possible to display the actual value. In that case, the display shows ---.

7 Function block "Enduser general"

This function block contains settings that the enduser himself can make, as well as indication of faults.

7.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
31	Weekday for switching program 2	1-7 (1…7 / 1-7)	
32	Start of first ON period	05:00 (--:-- / 00:00…24:00)	hh:mm
33	End of first ON period	22:00 (--:-- / 00:00…24:00)	hh:mm
34	Start of second ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
35	End of second ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
36	Start of third ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
37	End of third ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
38	Time of day	00:00…23:59	hh:mm
39	Weekday	Display function	
40	Date	(01.01…31.12)	dd:MM
41	Year	(1995…2094)	jjjj
50	Indication of errors	Display function	

7.2 Switching program 2

Switching program 2 can be used for one or several of the following functions:

- As a time switch program for the circulating pump
- As a time switch program for the release of d.h.w. heating
- As a time switch program for the multi-functional relay

Switching program 2 of the RVL481 affords a maximum of three ON periods per day. Also, every day of week may have different ON periods.
As with the heating program, it is not the "switching times" that are to be entered, but the periods of time during which the program or the controlled function shall be active.
Using setting "1-7" on operating line 31, it is possible to enter a switching program that applies to all weekdays. This simplifies the settings: if the weekend times are different, first enter the times for the entire week, then change days 6 and 7 as required.
The entries are sorted and overlapping ON periods combined.

7.3 Time of day and date

The RVL481 has a yearly clock to enter the time of day and the date.
The weekday on line 39 is set automatically with the date and cannot be adjusted.
The changeover from summer- to wintertime, and vice versa, takes place automatically. Should the respective standards change, the changeover dates can be adjusted (refer to chapter “25 Function block "Service functions and general settings"”.

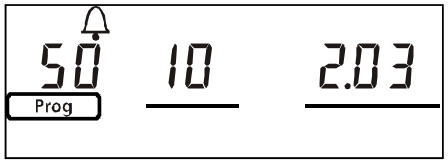
7.4 Indication of errors

The following errors are indicated:

Number	*Fault*
10	Fault outside sensor
30	Fault flow temperature sensor
40	Fault return temperature sensor (primary circuit)
42	Fault return temperature sensor (secondary circuit)
50	Fault storage tank temperature sensor/control thermostat 1
52	Fault storage tank temperature sensor/control thermostat 2
54	Fault d.h.w. flow temperature sensor
60	Fault room temperature sensor
61	Fault room unit
62	Wrong room unit connected
73	Fault collector sensor
81	Short-circuit on the bus (LPB)
82	Same bus address assigned several times (LPB)
100	Two clock masters on the bus (LPB)
120	Flow alarm
140	Inadmissible bus address or plant type (LPB)

If a fault occurs, the LCD displays 🔔.
In interconnected plants, the address (device and segment number) of the controller causing the fault is indicated on all the other controllers. No address will appear on the controller causing the fault.

Example of display in interconnected plants:



50 = operating line
10 = error number
2 = segment number
03 = device number

The error message disappears only after rectification of the fault. There will be no acknowledgement!

8 Function block "Plant type"

This function block only contains the selection of the plant type.

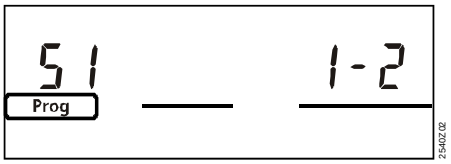
8.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
51	Plant type	1–1 (1–0…6–5)	

8.2 General

When commissioning the plant, the respective plant type must be entered first. This ensures that the functions required for the specific type of plant, the parameters and operating lines for the settings and displays will be activated.
All plant-specific variables and operating lines existing for the other plant types will then be hidden. They will not be displayed.

Example for an entry (selection of plant type 1–2)



51 = operating line
1 = Heating circuit plant type 1
2 = d.h.w. circuit type 2

9 Function block "Cascade slave"

This function block facilitates integration of the controller as a cascade slave into a heat source cascade. A heat source cascade is the combined operation of several oil- / gas-fired boilers.

9.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
59	Release integral for boiler sequence	200 (0…500)	°C×min
60	Reset integral of boiler sequence	50 (0…500)	°C×min

9.2 Mode of operation

The surplus heat or heat deficit of the boiler is ascertained with the help of the boiler sequence integral and communicated to the cascade master via LPB.

9.2.1 Boiler sequence release integral (KFI)

The boiler sequence release integral is a variable generated from the progression of the cascade flow temperature and time (t). If the variable falls below the setpoint, the difference will be communicated to the cascade master as the heat deficit.

$$KFI = \int_0^t \Delta T \, dt \quad \text{where: } \Delta T = (T_{VKw} - 0{,}5 \times SD - T_{VKx}) > 0$$

T_{VKw} Flow temperature setpoint of the cascade
T_{VKx} Actual value of cascade flow temperature
SD Switching differential of the boiler
t Time

9.2.2 Boiler sequence reset integral (KRI)

The boiler sequence reset integral is a variable generated from the progression of the cascade flow temperature and time (t). If the variable exceeds the setpoint, the difference will be communicated to the cascade controller as surplus heat.

$$KRI = \int_0^t \Delta T \, dt \quad \text{where: } \Delta T = (T_{VKx} - T_{VKw} + 0.5 \times SD) > 0$$

Note

Automatic boiler sequence changeover according to the number of burner operating hours is not possible with the RVL481 since this controller does not acquire the number of burner operating hours. Boiler management functions must be provided in the cascade master.

10 Function block "Space heating"

This function block performs the ECO function, the optimization functions with boost heating and quick setback, as well as the room influence.

10.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
61	Heating limit for NORMAL heating (ECO day)	17.0 (--.- / –5.0…+25.0)	°C
62	Heating limit for REDUCED heating (ECO night)	5.0 (--.- / –5.0…+25.0)	°C
63	Building time constant	20 (0…50)	h
64	Quick setback	1 (0 / 1)	
65	Room temperature source	A (0 / 1 / 2 / 3 / A)	
66	Type of optimization	0 (0 / 1)	
67	Maximum heating up time	00:00 (00:00…42:00)	hh:mm
68	Maximum early shutdown	0:00 (0:00…6:00)	h:mm
69	Maximum limitation of room temperature	--.- (--.- / 0…35)	°C
70	Gain factor of room influence	4 (0…20)	
71	Boost of room temperature setpoint	5 (0…20)	°C
72	Parallel displacement of the heating curve	0.0 (–4.5…+4.5)	°C
73	Heating curve slope	0 (0…2)	

10.2 ECO function

The ECO function controls space heating depending on demand. It gives consideration to the progression of the room temperature depending on the type of building construction as the outside temperature varies. If the amount of heat stored in the house or building is sufficient to maintain the room temperature setpoint currently required, the ECO function will switch the heating off.
When using the ECO function, the heating system operates only, or consumes energy only, when required.

10.2.1 Compensating variables and auxiliary variables

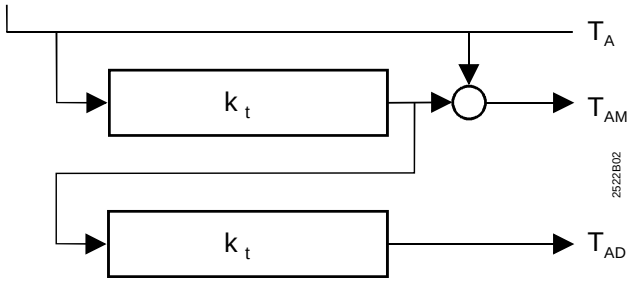
As compensating and auxiliary variables, the ECO function takes into account the development of the outside temperature and the heat storage capacity of the building.
The following variables are taken into consideration:

- The building time constant: this is a measure of the type of building construction and indicates how quickly the room temperature would change if the outside temperature was suddenly changed. The following guide values can be used for setting the building time constant:
  10 hours for light building structures
  25 hours for medium building structures
  50 hours for heavy building structures
- The actual outside temperature (T_A)
- The composite outside temperature (T_{AM}), which is the mean value of:
  - the actual outside temperature, and
  - the outside temperature filtered by the building time constant

  Compared with the actual outside temperature, the composite outside temperature is attenuated. Hence, it represents the effects of short-time outside temperature variations on the room temperature as they often occur during intermediate seasons (spring and autumn)
- The attenuated outside temperature (T_{AD}): it is generated by filtering twice the actual outside temperature by the building time constant. This means that, compared with the actual outside temperature, the attenuated outside temperature is considerably dampened. This ensures that no heating will take place in the summer when, under normal

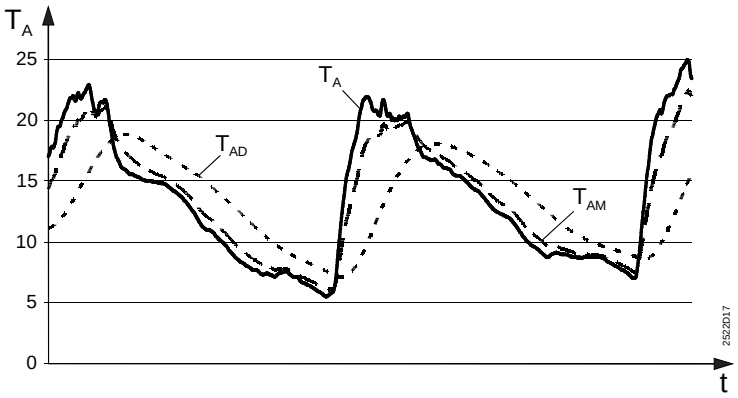
circumstances, the heating would be switched on because the outside temperature drops for a few days

T_A (B9 rsp. BUS)



Generation of the composite and attenuated outside temperature

T_A Actual outside temperature
T_{AD} Attenuated outside temperature
T_{AM} Composite outside temperature
k_t Building time constant



Progression of the actual, composite and attenuated outside temperature

T_A Actual outside temperature
T_{AD} Attenuated outside temperature
T_{AM} The composite outside temperature
t Time

10.2.2 Heating limits

The following heating limits can be set:

- "ECO day" for NORMAL heating
- "ECO night" for the lower temperature level. This can be REDUCED heating or OFF (holidays / frost protection)

In both cases, the heating limit is the outside temperature at which the heating shall be switched on and off. The switching differential is 1 °C.

10.2.3 Mode of operation

Switching the heating off

The heating will be switched off when **one** of the 3 following conditions is satisfied:

- The actual outside temperature exceeds the current ECO heating limit
- The composite outside temperature exceeds the current ECO heating limit
- The attenuated outside temperature exceeds the "ECO day" heating limit

In all these cases, it is assumed that the amount of heat entering the building envelope from outside or the amount of heat stored in the building structure will be sufficient to maintain the required room temperature level.

When the ECO function has switched the heating off, the display shows **ECO.**

Switching the heating on

The heating will be switched on again only when **all** 3 of the following conditions are satisfied:

- The actual outside temperature has fallen 1 °C below the current ECO heating limit
- The composite outside temperature has fallen 1 °C below the current ECO heating limit
- The attenuated outside temperature has fallen 1 °C below the "ECO day" heating limit

10.2.4 Operating modes and operating states

The ECO function is performed depending on the operating mode:

Operating mode or operating state		*ECO function*	*Current heating limit*
Auto	Automatic operation	active	ECO day or ECO night
	Continuously REDUCED heating	active	ECO night
	Continuously NORMAL heating	inactive	–
	Protection mode / holiday mode	active	ECO night
	Manual operation	inactive	–

10.3 Room temperature source

The outside temperature source can be selected on operating line 65.
The following settings are available:

Operating line 65 SET	*Room temperature source*
0	No room sensor
1	Room unit at terminal A6
2	Room sensor connected to terminal B5
3	Average of devices connected to A6 and B5
A	Automatic selection

Operating line 65 also displays the room temperature source actually used by the controller (*ACTUAL*).

ACTUAL = 0 controller operates without a sensor
ACTUAL = 1 controller operates with a room unit connected to terminal A6
ACTUAL = 2 controller operates with a room sensor connected to terminal B5
ACTUAL = 3 controller operates with the mean value of the devices connected to A6 and B5

10.4 Optimization

10.4.1 Definition and purpose

Operation of the heating system is optimized. According to EN 12 098, optimization is the "automatic shifting of the switch-on and switch-off points aimed at saving energy". This means that:

- Switching on and heating up as well as switching off are controlled such that during building occupancy times the required room temperature level will always be ensured
- The smallest possible amounts of energy will be used to achieve this objective

10.4.2 Fundamentals

It is possible to select or set:

- The type of optimization: either with a room sensor / room unit or based on the room model
- The maximum limit value for the heating-up time
- The maximum limit value for optimum shutdown
- Quick setback: Yes or no

To perform the optimization function, the controller makes use of the actual room temperature – acquired by a room temperature sensor or room unit – or the room model.

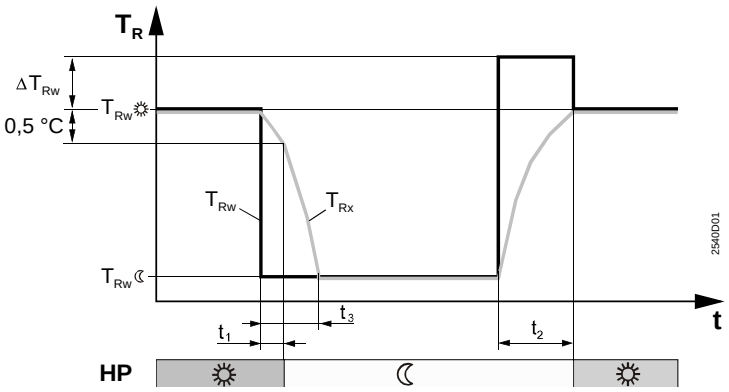
With room sensor

Using a room sensor or room unit, it is possible to have optimum start **and** optimum stop control.
To be able to optimally determine the switch-on and switch-off points, optimization needs to "know" the building's heating up and cooling down characteristics, always as a function of the prevailing outside temperature. For this purpose, optimization continually acquires the room temperature and the respective outside temperature. It captures these variables via the room temperature sensor and the outside sensor and continually adjusts the forward shift of the switching points. In this ways, optimization can also detect changes made to the house or building and to take them into consideration.
The learning process always concentrates on the first heating period per day.

Without room sensor

When no room temperature sensor is used, the room model **only** allows optimum start control.
Optimization operates with fixed values (no learning process), based on the set maximum heating up time and the room model.

10.4.3 Process



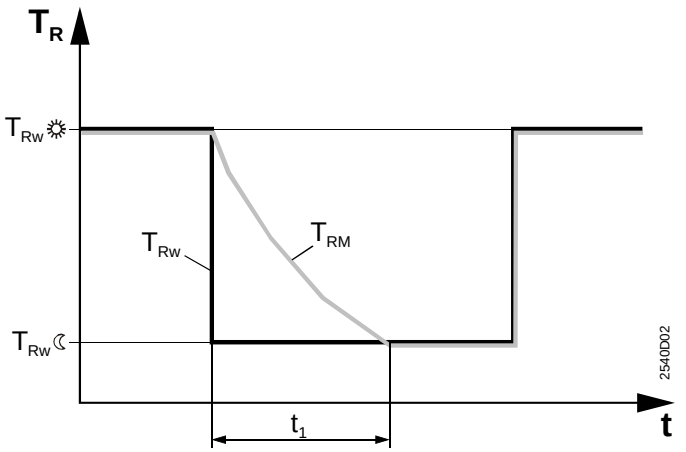
HP	Heating program
T_R	Room temperature
t	Time
t_1	Forward shift for early shutdown
t_2	Forward shift for the start of heating up
t_3	Quick setback
TRw	Room temperature setpoint
T_{Rw}☼	Setpoint of NORMAL room temperature
T_{Rw}☾	Setpoint of REDUCED room temperature
ΔTRw	Boost of room temperature setpoint (with boost heating)
TRx	Actual value of the room temperature

10.4.4 Room model temperature

To ascertain the room temperature generated by the room model, a distinction must be made between 2 cases:

- The RVL481 is not in quick setback mode:
  The room temperature generated by the room model is identical to the current room temperature setpoint
- The RVL481 is in setback mode:
  The room temperature generated by the room model is determined according to the following formula:

  Room model temperature $T_{RM} = (T_{Rw}☼ - T_{AM}) \times e^{-\frac{t}{3 \times kt}} + T_{AM}$ [°C]



Progression of room temperature generated by the room model

e	2.71828 (basis of natural logarithms)
k_t	Building time constant in hours
t	Time in hours
t_1	Quick setback
T_{AM}	Composite outside temperature
T_R	Room temperature
T_{RM}	Room model temperature
T_{Rw}☼	Setpoint of NORMAL room temperature
T_{Rw}☾	Setpoint of REDUCED room temperature

10.4.5 Optimum stop control

During the building's occupancy time, the RVL481 maintains the setpoint of NORMAL heating. Towards the end of the occupancy time, the control switches to the REDUCED setpoint. Optimization calculates the changeover time such that, at the end of occupancy, the room temperature will lie 0.5 °C below the setpoint of NORMAL heating (optimum shutdown).
By entering 0 hours as the maximum optimum shutdown, optimum stop control can be deactivated.

10.4.6 Quick setback

When changing from the NORMAL temperature to a lower temperature level (REDUCED or holidays / frost), the heating will be shut down. And it will remain shut down until the setpoint of the lower temperature level is reached.

- When using a room temperature sensor, the effective actual value of the room temperature is taken into account
- When using no room sensor, the actual value is simulated by the room model.
  The duration is determined according to the following formula:

$$t = 3 \times kt \times \left(\ln \frac{T_{Rw☾} - T_{AM}}{T_{Rw☼} - T_{AM}}\right) \text{ [h]}$$

ln	Natural logarithm
k_t	Building time constant in hours
t	Duration of quick setback
T_{AM}	Composite outside temperature
T_{Rw}☼	Setpoint of NORMAL room temperature
T_{Rw}☾	Setpoint of REDUCED room temperature

10.4.7 Optimum start control

During the building's non-occupancy times, the RVL481 maintains the setpoint of REDUCED heating. Toward the end of the non-occupancy time, optimization switches the control to boost heating. This means that the selected boost will be added to the room temperature setpoint. Optimization calculates the changeover time such that, at the start of occupancy, the room temperature will have reached the setpoint of NORMAL heating.
When the room temperature is simulated by the room model, that is, when using no room temperature sensor, the forward shift in time is calculated as follows:

$t = (T_{Rw☼} - T_{RM}) \, 3 \times kt$ [min]

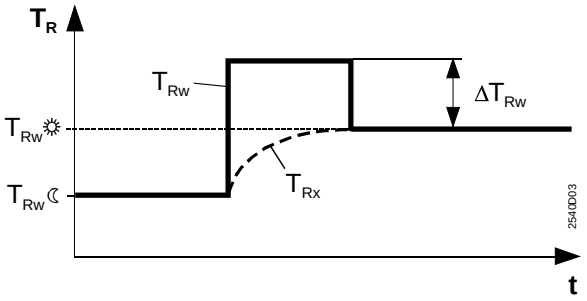
k_t	Building time constant in hours
t	Forward shift
$T_{Rw☼}$	Setpoint of NORMAL room temperature
T_{RM}	Room model temperature

Optimum start control with the room model takes place only if, previously, quick setback took place.

Optimum start control can be deactivated by entering 0 hours as the maximum heating up period.

10.4.8 Boost heating

For boost heating, a room temperature setpoint boost can be set.
After changeover to the NORMAL temperature, the higher room temperature setpoint applies, resulting in an appropriately higher flow temperature setpoint.
D.h.w. heating during boost heating does not affect the latter.



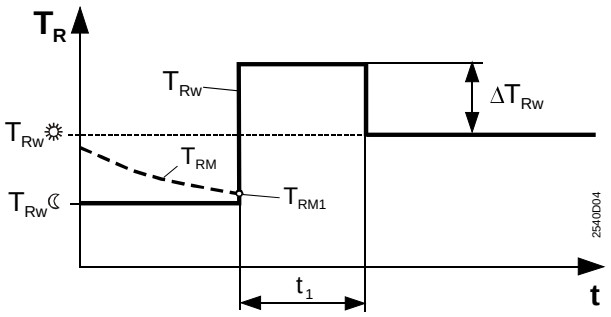
t	Time
T_R	Room temperature
$T_{Rw☼}$	Setpoint of NORMAL room temperature
$T_{Rw☾}$	Setpoint of REDUCED room temperature
TRx	Actual value of the room temperature
TRw	Room temperature setpoint
ΔTRw	Boost of room temperature setpoint (with boost heating)

Duration of boost:

- When using a room temperature sensor, boost heating is maintained until the room temperature has reached the setpoint of NORMAL heating. Then, that setpoint will be used again
- When using no room temperature sensor, the room model calculates how long boost heating will be maintained. The duration is determined according to the following formula

$$t_1 = 2 \times \frac{T_{Rw☼} - T_{RM1}}{T_{Rw☼} - T_{Rw☾}} \times \frac{kt}{20} \quad [h]$$

The duration of the boost is limited to 2 hours.



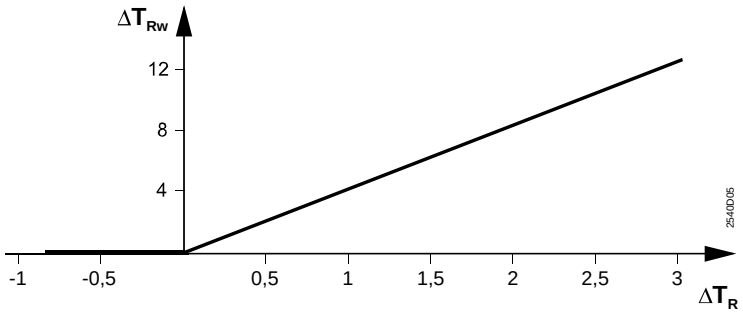
k_t	Building time constant in hours
t	Time
t_1	Duration of room temperature setpoint boost with boost heating
T_R	Room temperature
T_{Rw}☼	Setpoint of NORMAL room temperature
T_{Rw}☾	Setpoint of REDUCED room temperature
T_{RM}	Room model temperature
T_{RM1}	Room model temperature at the beginning of boost heating
TRw	Room temperature setpoint
ΔTRw	Boost of room temperature setpoint (with boost heating)

10.5 Room functions

10.5.1 Maximum limitation of the room temperature

For the room temperature, it is possible to have an adjustable maximum limitation. For that purpose, a room sensor is required (sensor or room unit).
If the room temperature lies 1 °C above the limit value, the room temperature setpoint will be lowered by 4 °C.
Maximum limitation of the room temperature is independent of the setting used for the room influence.
If the room temperature lies above the limit value, the display shows Γ .
The reduction of the flow temperature setpoint ΔT_{Vw} is calculated as follows:

$\Delta T_{Vw} = \Delta T_{Rw} \times (1 + s)$ [K]

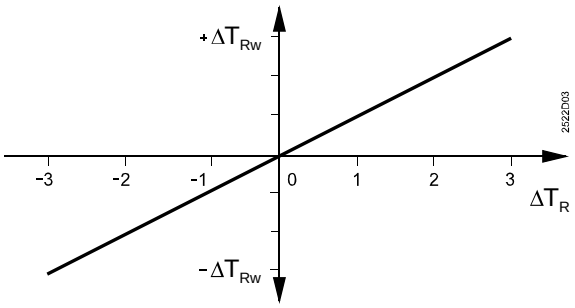


s	Heating curve slope
ΔTRw	Reduction of the room temperature setpoint
ΔT_R	Deviation of the room temperature
ΔTVw	Reduction of the flow temperature setpoint

10.5.2 Room influence

The room temperature is included in the control process. For that purpose, a room sensor is required (sensor or room unit).
The gain factor of the room temperature influence on the flow temperature control can be adjusted. This indicates to what extent deviations of the actual room temperature from the setpoint have an impact on the flow temperature control:
0 = room temperature deviations have no impact on the generation of the setpoint
20 = room temperature deviations have a maximum impact on the generation of the setpoint
The change of the room temperature setpoint ΔT_{Rw} is calculated according to the following formula:

$$\Delta T_{Rw} = \frac{VF}{2} \times (T_{Rw} - T_{Rx}) \quad [K]$$



The change of the flow temperature setpoint ΔT_{Vw} resulting from the change of the room temperature setpoint is calculated as follows:

$$\Delta T_{Vw} = \Delta T_{Rw} \times (1 + s) \quad [K]$$

s	Heating curve slope
TRw	Room temperature setpoint
ΔTRw	Change of room temperature setpoint
–ΔTRw	Decrease of room temperature setpoint
+ΔTRw	Increase of room temperature setpoint
TRx	Actual value of the room temperature
ΔT_R	Room temperature deviation ($T_{Rw} – T_{Rx}$)
ΔTVw	Change of flow temperature setpoint
VF	Gain factor

10.6 Heating curve

10.6.1 Purpose

With the space heating systems (plant types 1–x, 2–x, and 3–x), flow temperature control is always weather-compensated. The assignment of the flow temperature setpoint to the prevailing outside temperature is made via the heating curve.

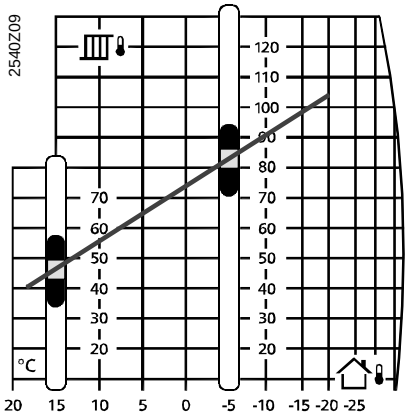
10.6.2 Basic setting

The setting of the heating curve is made via the bar or 2 operating lines. The following settings are required:

- Flow temperature setpoint at an outside temperature of –5 °C
- Flow temperature setpoint at an outside temperature of +15 °C

The basic setting during commissioning is made according to the planning documentation or in agreement with local practices.

Setting with the bar



Setting on the operating lines

The setting is to be made on operating lines 14 and 15.

Operating line	*Setpoint*
14	TV1, current flow temperature setpoint at an outside temperature of 15 °C
15	TV2, current flow temperature setpoint at an outside temperature of –5 °C

Selection of setting

The type of setting is to be entered on operating line 73.

Operating line 73	*Bar*	*Operating line 14*	*Operating line 15*
0	Acting	No action	No action
1	No action	Acting	Acting
2	No action	Display function only, adjustment only via LPB	Display function only, adjustment only via LPB

10.6.3 Deflection

The heat losses of a building are proportional to the difference between room temperature and outside temperature. By contrast, the heat output of radiators does not increase proportionally when the difference between radiator and room temperature increases. For this reason, the radiators' heat exchanger characteristic is deflected. The heating curve's deflection takes these characteristics into consideration.
In the range of small slopes (e.g. with underfloor heating systems), the heating curve is practically linear – due to the small flow temperature range – and therefore corresponds to the characteristic of low temperature heating systems.
The slope ”s” is determined according to the following formula:

$$s = \frac{T_{Vw(-5)} - T_{Vw(+15)}}{20\ K}$$

s Heating curve slope
$T_{Vw(-5)}$ Flow temperature setpoint at an outside temperature of –5 °C
$T_{Vw(+15)}$ Flow temperature setpoint at an outside temperature of +15 °C

On the controller, the heating curve is shown as a straight line. This straight line corresponds exactly to the deflected heating curve, because the non-linear outside temperature scale corresponds to the deflection.
The heating curve is valid for a room temperature setpoint of 20 °C.

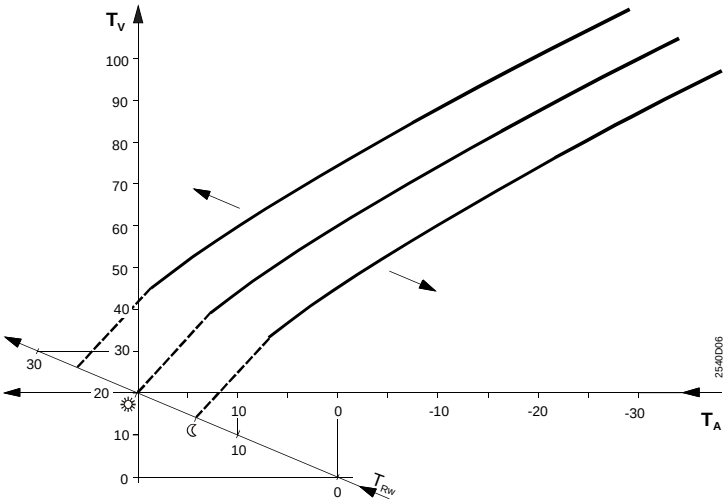
10.6.4 Parallel displacement of heating curve

The heating curve can be displaced parallel:

- Manually with the setting knob for room temperature readjustments. The readjustment can be made by the enduser and covers a maximum range of –4.5…+4.5 °C room temperature
- Manually on operating line 72

The parallel displacement of the heating curve is calculated as follows:

Parallel displacement $\Delta T_{Flow} = (\Delta T_{Knob} + \Delta T_{Operating\ line\ 72}) \times (1 + s)$



Parallel displacement of heating curve

s Slope
T_A Outside temperature
T_V Flow temperature
T_{Rw} Room temperature setpoint

10.6.5 Display of setpoints

2 current setpoints result from the basic setting, the position of the setting knob and – if made – the entry on operating line 72, which can be called up on operating line 166:

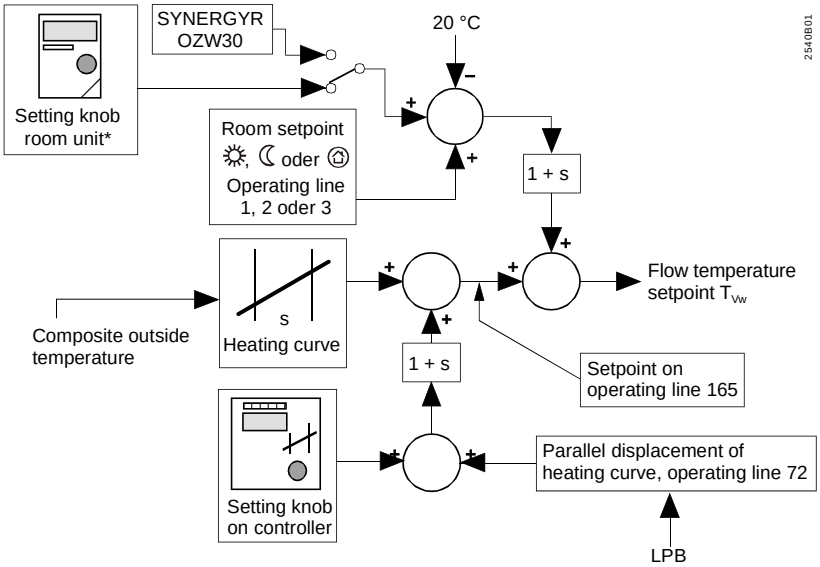
- Resultant flow temperature setpoint at an outside temperature of +15 °C
- Resultant flow temperature setpoint at an outside temperature of –5 °C

These 2 current setpoints determine the actual heating curve from which – as a function of the composite outside temperature – the current flow temperature setpoint is generated. It can be called up on operating line 165 (also refer to chapter “25 Function block "Service functions and general settings"").

10.7 Generation of setpoint

10.7.1 Weather-compensated control

Weather-compensated control is used with plant types 1–x, 2–x and 3–x. The setpoint is generated via the heating curve as a function of the outside temperature. The temperature used is the **composite** outside temperature.



LPB Data bus
OZW30 SYNERGYR central unit
s Slope
* Active only with room unit level

The impact of the central unit OZW30 is described in section “28.2 Combination with SYNERGYR central unit OZW30 described.

10.7.2 Demand-compensated control

Demand-compensated control is used with plant types 4–x, 5–x, and 6–x.
The setpoint is delivered to the RVL481 via the data bus (LPB) in the form of a heat demand signal. In that case, the outside temperature will not be taken into consideration.

11 Function block "3-position actuator heating circuit"

This function block provides 3-position control of the heating circuit. Depending on the plant type, it acts as follows:

- Weather-compensated, on the mixing valve of a space heating system (plant type 1–x)
- Weather-compensated, on the valve in the primary return of a space heating system with a district heat connection (plant type 3–x)
- Demand-compensated, on the mixing valve of a main flow (plant type 4–x)
- Demand-compensated, on the valve in the primary return of a main flow with district heat connection (plant type 6–x)

11.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
81	Maximum limitation of flow temperature	--- (--- / 0…140)	°C
82	Minimum limitation of flow temperature	--- (--- / 0…140)	°C
83	Maximum rate of flow temperature increase	--- (--- / 1…600)	°C/h
84	Flow temperature boost mixing valve / heat exchanger	10 (0…50)	°C
85	Actuator running time	120 (30…873)	s
86	P-band of control (Xp)	32.0 (1…100)	°C
87	Integral action time of control (Tn)	120 (30…873)	s

11.2 Limitations

11.2.1 Flow temperature limitations

Settings

The following settings can be made:

- Maximum limitation of the flow temperature. At the limit value, the heating curve runs horizontally. This means that the flow temperature setpoint cannot exceed the maximum value
- Minimum limitation of the flow temperature: At the limit value, the heating curve runs horizontally. This means that the flow temperature setpoint cannot fall below the minimum value (exception: with locking signals)

If the setpoint is limited, the display shows:

⌜ = for maximum limitation

⌟ = for minimum limitation

Both limitations can be deactivated (setting ---).

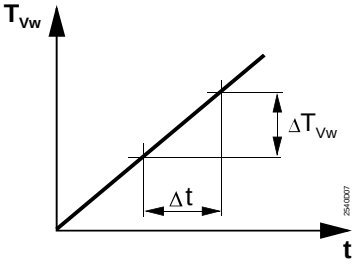
Impact on d.h.w. heating

Minimum limitation is also active during storage tank charging, depending on the kind of priority.

With plant types 3–1 and 3-3, where maximum limitation is not active during storage tank charging.

11.2.2 Setpoint rise

Function



Maximum rise: = $\frac{\Delta T_{Vw}}{\Delta t}$

t Time
Δt Unit of time
TVw Flow temperature setpoint
ΔTVw Rate of setpoint increase per unit of time

The rate of increase of the flow temperature setpoint can be limited to a maximum. In that case, the maximum rate of increase of the flow temperature setpoint is the selected temperature per unit of time (°C per hour). This function:

- prevents cracking noises in the piping
- protects objects and construction materials that are sensitive to quick temperature increases (e.g. antiquities)
- prevents excessive loads on heat generating equipment

This function can be deactivated (setting **---**).

Effect on d.h.w. heating

During d.h.w. heating, limitation of the rate of increase acts as follows:

Plant type	*Effect*
1–x 3–0 3–2 3–4 3–5 4–x 6–x	Limitation of the rate of increase is always active
3–1 3–3	Limitation of the rate of increase only acts with shifting or parallel d.h.w. priority

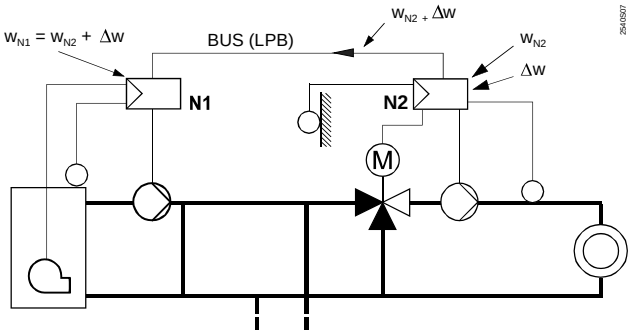
11.3 3-position control

3-position control operates as weather- or demand-compensated PI flow temperature control. The flow temperature is controlled through a modulating actuating device (slipper or seat valve). Owing to the I-part, there is no control offset.
The controller's positioning commands to the actuator of the actuating device are fed to the output relays and indicated by LEDs.

11.4 Excess mixing valve or heat exchanger temperature

In interconnected plants, an excess mixing valve or heat exchanger temperature can be entered on the RVL481. This is a boost of the respective heating zone's flow temperature setpoint. The higher setpoint is delivered to the heat source as the heat demand signal.
The excess mixing valve or heat exchanger temperature is set on the controller that drives the mixing valve (controller N2 in the example below) (operating line 84).

Example interconnected plant



N1 Boiler temperature controller (heat generation)
N2 Flow temperature controller (heating zone)
w_{N1} Setpoint of boiler temperature controller
w_{N2} Setpoint of flow temperature controller
Δw Excess mixing valve temperature (set on controller N2)

11.5 Pulse lock

If, during a period of time that equals five times the running time, the actuator has received only closing pulses, additional closing pulses delivered by the controller will be locked. This minimizes the strain on the actuator.
For safety reasons, the controller delivers a one-minute closing pulse at 10-minute intervals.
An opening pulse negates the pulse lock.

12 Function block "Boiler"

Function block "Boiler" acts as a 2-position controller and is used for direct burner control. Depending on the type of plant, it acts as a:

- boiler temperature controller for weather-compensated control of a space heating system (plant type 2–x)
- boiler temperature controller for demand-compensated control of a main flow (plant type 5–x)

12.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
91	Operating mode of the boiler	0 (0 / 1)	
92	Maximum limitation of the boiler temperature	95 (25…140)	°C
93	Minimum limitation of the boiler temperature	10 (5…140)	°C
94	Switching differential of the boiler	6 (1…20)	°C
95	Minimum limitation of the burner running time	4 (0…10)	min
96	Release limit for second burner stage	50 (0…500)	°C×min
97	Reset limit for second burner stage	10 (0…500)	°C×min
98	Waiting time for second burner stage	20 (0…40)	min
99	Operating mode pump M1	1 (0 / 1)	

12.2 Operating mode

The boiler's operating mode for situations when there is no demand for heat (e.g. due to the ECO function),can be selected: 3 operating modes are available:

- With manual shutdown: The boiler will be shut down when there is no demand for heat and protection mode is selected (setting 0 on operating line 91)
- With automatic shutdown: The boiler will be shut down when there is no demand for heat, irrespective of the selected operating mode (setting 1 on operating line 91)

Boiler operating modes, when there is no demand for heat:

Controller's operating mode		*Boiler operating mode* *with manual shutdown*	*with automatic shutdown*
	Protection	Boiler OFF	Boiler OFF
Auto	AUTO	Boiler at minimum limit value	Boiler OFF
	REDUCED	Boiler at minimum limit value	Boiler OFF
	NORMAL	Boiler at minimum limit value	Boiler OFF

With plant types 5–x, it is not possible to select all operating modes (refer to section "3.7 Plant type and operating mode").
When there is demand for heat, the boiler always supplies heat, which means that the boiler's operating mode in that case is always ON.

12.3 Limitations

12.3.1 Maximum limitation of the boiler temperature

For maximum limitation of the boiler temperature, the maximum limit value can be adjusted. The switch-off point cannot exceed the maximum limit value. The switch-on point will then be lower by the amount of the set switching differential.
If the return temperature is limited, the display shows .
This maximum limitation cannot be used as a safety function; for that purpose, thermostats, thermal reset limit thermostats, etc., must be used.

12.3.2 Minimum limitation of the boiler temperature

For minimum limitation of the boiler temperature, the minimum limit value can be adjusted. The switch-on point cannot fall below the minimum limit value. The switch-off point will then be higher by the amount of the set switching differential
If the return temperature is limited, the display shows ⌋.

12.3.3 Actions during d.h.w. heating

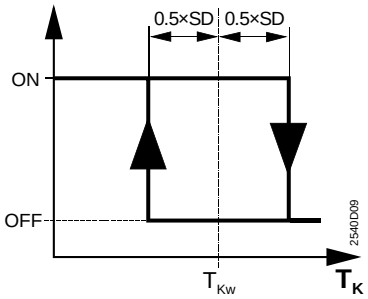
Both the maximum and the minimum limitation also act during d.h.w. heating.

12.4 2-position control

2-position control maintains the required boiler temperature by switching a single- or 2-stage burner on and off.
The controller's commands to the burner or burner stages are delivered via the output relays and indicated by LEDs.

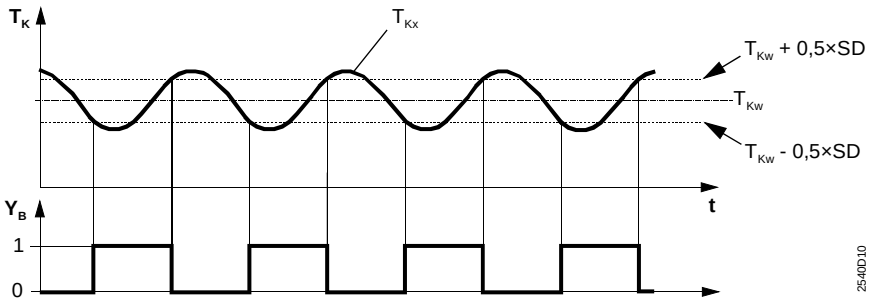
12.4.1 Control with a single-stage burner

For 2-position control with a single-stage burner, the variables that can be set are the switching differential and the minimum burner running time.
The controller compares the actual value of the boiler temperature with the setpoint. If the boiler temperature falls below the setpoint by half the switching differential, the burner will be switched on. If the boiler temperature exceeds the setpoint by half the switching differential, the burner will be switched off.



SD Switching differential
TK Boiler temperature
TKw Boiler temperature setpoint

If there is no more deviation before the minimum burner running time has elapsed, the burner will nevertheless continue to operate until that period of time is completed (burner cycling protection). This means that the minimum burner running time has priority. Maximum limitation of the boiler temperature will be maintained, however, which always leads to burner shutdown.



SD Switching differential
t Time
T_K Boiler temperature
T_{Kw} Boiler temperature setpoint
T_{Kx} Actual value of boiler temperature
Y_B Burner control signal

Note

When controlling a single-stage burner, the reset limit of the second stage should be set to zero.

12.4.2 Control with a 2-stage burner

Setting parameters

For 2-position control with a 2-stage burner, the variables that can be set are the switching differential and the minimum burner running time – which now apply to both stages – plus the following variables:

- The release integral (FGI) for the second stage. This is the variable generated from the temperature (T) and time (t). If the maximum limit is exceeded, the second burner stage is released and can switch on, provided the minimum waiting time for the second stage has elapsed. Prerequisite is that the minimum locking time for the second stage has elapsed.

  FGI = $\int_0^t \Delta T \, dt$ where: ΔT = (w – 0,5 × SD – x) > 0

- The reset limit (RSI). This is the variable generated from the temperature (T) and time (t). If the maximum limit is exceeded, the burner will be locked and switches off

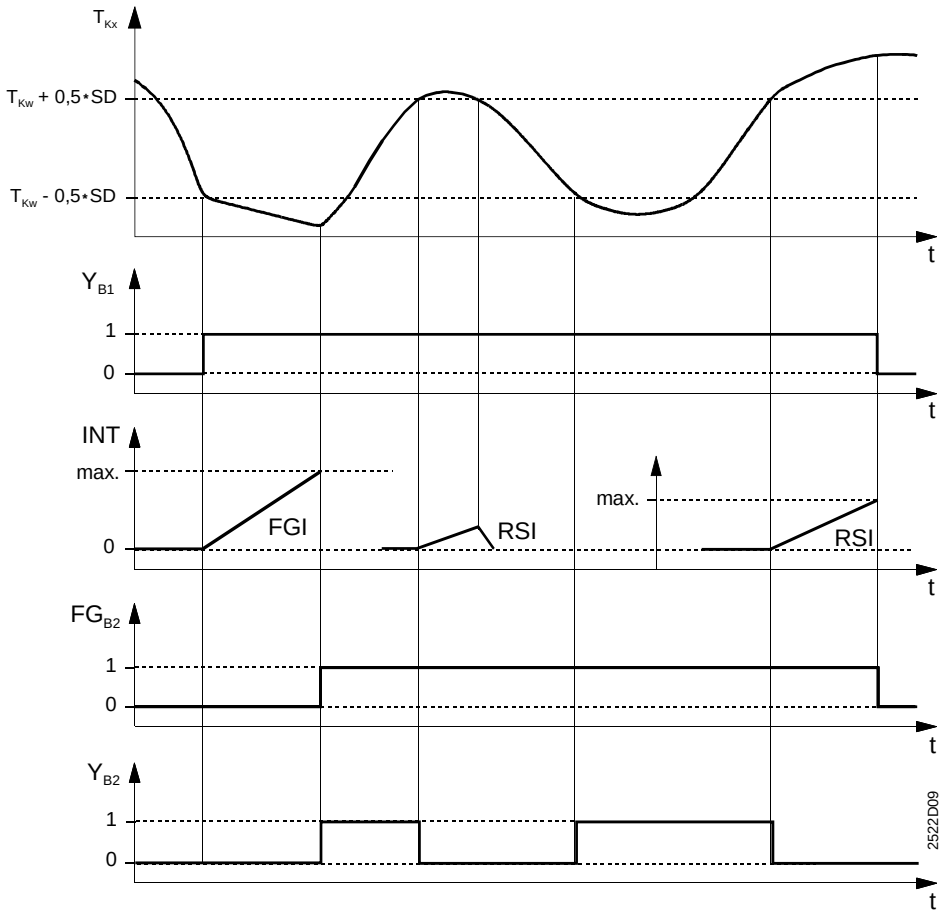
  RSI = $\int_0^t \Delta T \, dt$ where: ΔT = (x – w + 0,5 × SD) > 0

- The minimum locking time for the second stage, which is the period of time on completion of which the second stage can switch on at the earliest

Control process

The controller compares the actual value of the flow temperature with the setpoint. If it falls below the setpoint by half the switching differential (x < w – 0.5 × SD), the first burner stage will be switched on. At the same time, the minimum waiting time for the second burner stage commences and the release integral is being generated. The controller ascertains for how long and by how much the flow temperature remains below w – 0.5 × SD. It continually generates the integral based on the time and the progression of temperature.
If, on completion of the minimum locking time, the flow temperature is below w – 0.5 × SD, and if the release limit reaches the set maximum limit, the second burner stage will be released and switched on. The flow temperature starts rising.
When the flow temperature has exceeded the setpoint by half the switching differential (x = w + 0.5 × SD), the second burner stage is switched off again, but will remain released. The first stage continues to operate. If the flow temperature drops, the second stage will be switched on again at × < w – 0.5 × SD. The setpoint is now maintained by the second burner stage.
If, however, the flow temperature continues to rise (x > w + 0.5 × SD), the controller starts generating the reset integral. It determines for how long and to what extent the flow temperature stays above the setpoint by half the switching differential. It continually generates the integral based on time and the progression of temperature. When the reset limit reaches the set maximum limit, the second burner stage will be locked and the first stage switched off.
The minimum locking time and calculation of the release integral at × < w – 0.5 × SD are started when the switch-on command for the first burner stage is given.
Due to the time-temperature integral, it is not only the duration of the deviation that is considered, but also its extent, when deciding whether the second stage shall be switched on or off.

SD Switching differential
w Boiler temperature setpoint
x Actual value of boiler temperature



FG_{B2}	Release of burner stage 2
FGI	Release integral
INT	Integral
RSI	Reset integral
SD	Switching differential
t	Time
TKw	Boiler temperature setpoint
TKx	Actual value of boiler temperature
Y_{B1}	Control signal for burner stage 1
Y_{B2}	Control signal for burner stage 2

12.4.3 Frost protection for the boiler

Frost protection for the boiler operates with fixed values:

- Switch-on point: 5 °C boiler temperature
- Switch-off point: Minimum limit of the boiler temperature plus switching differential

If the boiler temperature falls below 5 °C, the burner will always be switched on until the boiler temperature has crossed the minimum limit by the amount of the switching differential.

12.4.4 Protective boiler startup

If the boiler temperature falls below the minimum limit of the boiler temperature while the burner is running, the differential (minimum limit value minus actual value) will be integrated. From this, a critical locking signal will be generated and transmitted to the connected loads. This causes the loads to reduce their setpoints, thus consuming less energy. If the critical locking signal exceeds a defined value, the boiler pump will be deactivated also.

If the boiler temperature returns to a level above the minimum limit, the integral will be reduced, resulting in a reduction of the critical locking signal. If the integral falls below a defined level, the circulating pump will be activated again if it had been switched off. The connected loads rise their setpoint values.

When the integral reaches the value of zero, protective boiler startup will be deactivated, in which case the critical locking signal is zero.

Protective boiler startup can be interrupted to ensure that, in the event of a burner fault, for instance, frost protection for the plant will be provided.

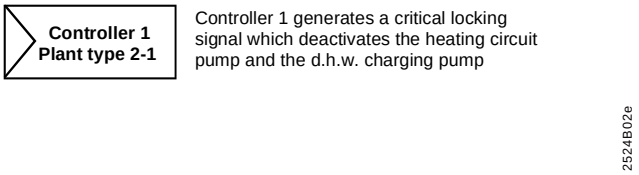
In the case of protective boiler startup and simultaneous frost protection for the plant, the boiler temperature gradient must turn positive within 15 minutes. Otherwise, the locking signal will become invalid for at least 15 minutes. On completion of the 15 minutes, protective boiler startup will become active again as soon as the boiler temperature gradient turns positive.

If the boiler carries out protective boiler startup, the boiler temperature controller's display shows ⌟.

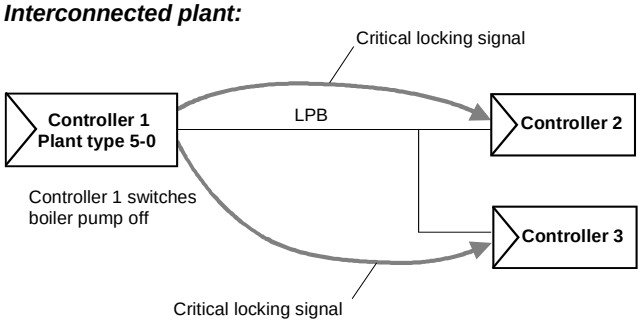
Protective boiler startup cannot be deactivated.

Section “25.4.7 Gain of locking signal” provides information on who receives the boiler temperature controller's critical locking signal and how the consumers respond to it.

Individual unit:

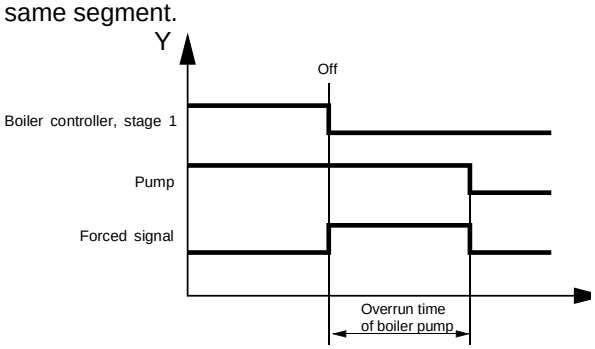


Interconnected plant:



12.4.5 Protection against boiler overtemperatures

To prevent heat from building up in the boilers (protection against overtemperatures), the RVL481 offers a protective function.
When the first burner stage is switched off, the controller allows pump M1 to overrun for the set pump overrun time (operating line 174 on the boiler temperature controller), generating at the same time a forced signal to all loads (inside the controller on the data bus). If the boiler temperature controller is located in segment “0”, the forced signal will be delivered to all loads in all segments. By contrast, if the boiler temperature controller is located in segment 1…14, the signal will only be sent to the loads in the same segment.



t Time
Y Control signal boiler pump

All loads (heating and d.h.w. circuits) and heat converters that abruptly reduce their demand for heat watch the data bus during the set pump overrun time to see if a forced signal is being sent by the boiler.

- If no forced signal is received, the consumers and heat converters only allow pump overrun to take place (refer to section “25.4.4 Pump overrun“)
- If, in this time window, a forced signal is received, the loads continue to draw heat from the boiler in the following manner:
  - Plant types with heating circuits using a mixing valve maintain the previous set-point
  - Plant types with pump heating circuits allow the pumps to continue running

D.h.w. plant type 4 (instantaneous d.h.w. heating via heat exchanger) does not respond to forced signals since it can draw heat from the boiler only if there is demand for d.h.w.
If the boiler sets the forced signal to zero, the loads and heat exchanges that have responded to the forced signal respond as follows:

- They close their mixing valves
- Their pumps run for the set pump overrun time and then stop

D.h.w. discharging protection has priority over protection against boiler overtemperatures.

12.5 Operating mode of pump M1

The operating mode during protective boiler start-up of pump M1 must be selected on operating line 99:

- Circulating pump with no deactivation (setting 0):
  The circulating pump runs when one of the consumers calls for heat and when burner stage 1 is switched on, that is, also during protective boiler startup.
- Circulating pump with deactivation (setting 1):
  The circulating pump runs when one of the consumers calls for heat. It is deactivated during protective boiler startup.

13 Function block "Setpoint of return temperature limitation"

On the function block "Setpoint of return temperature limitation", the setpoint of minimum limitation of the return temperature or the constant value for shifting maximum limitation of the return temperature can be adjusted.

13.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
101	Setpoint of return temperature limitation – Constant value	--- (--- / 0…140)	°C

13.2 Description

On operating line 101, the setpoint of minimum limitation of the return temperature or the constant value for shifting maximum limitation of the return temperature can be adjusted.
When entering ---, the function is deactivated, which means that the return temperature will not be limited.
For more detailed information about the maximum limitation of the return temperature, refer to chapter “14 Function block "District heat".
If the settings of this function block have been locked (contact H3, or on operating line 248; refer to the respective sections), the display shows OFF when pressing buttons − and +.

13.3 Minimum limitation of the return temperature

This function block ensures minimum limitation of the boiler return temperature where possible or required. This applies to the following plant types:

- Plant type 1–x, Heating circuit control with mixing group
- Plant type 4–x, Precontrol with mixing group
- Plant type 5–x, Precontrol with boiler

Minimum limitation of the return temperature prevents boiler corrosion due to flue gas condensation.

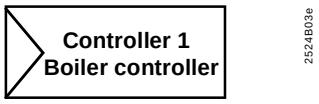
13.3.1 Acquisition of measured values

A temperature sensor with a sensing element LG-Ni 1000 is required in the return. With plant type 1–x, the return temperature can also be delivered via LPB. In interconnected plants, only one return temperature sensor per segment may be used.

13.3.2 Mode of operation

If the return temperature falls below the set minimum limit value, the temperature differential between minimum limit value and actual value will be integrated. From this, a critical locking signal will be generated and transmitted to the connected loads. This causes the loads to reduce their setpoints, thus consuming less energy.
If the return temperature returns to a level above the minimum limit, the integral will be reduced, resulting in a reduction of the critical locking signal. The connected loads rise their setpoint values.
When the integral reaches the value of zero, the minimum return temperature limitation will be deactivated, in which case the critical locking signal is zero.
If minimum limitation of the return temperature is active, the display shows J.
Minimum limitation of the return temperature can be deactivated.
Section “25.4.7 Gain of locking signal” provides information on which the critical locking signal is sent to and how the consumers respond to it.
The minimum limit value is to be set on operating line 101. Setting --- = (inactive)

13.3.3 Mode of operation with a single device (with no bus)



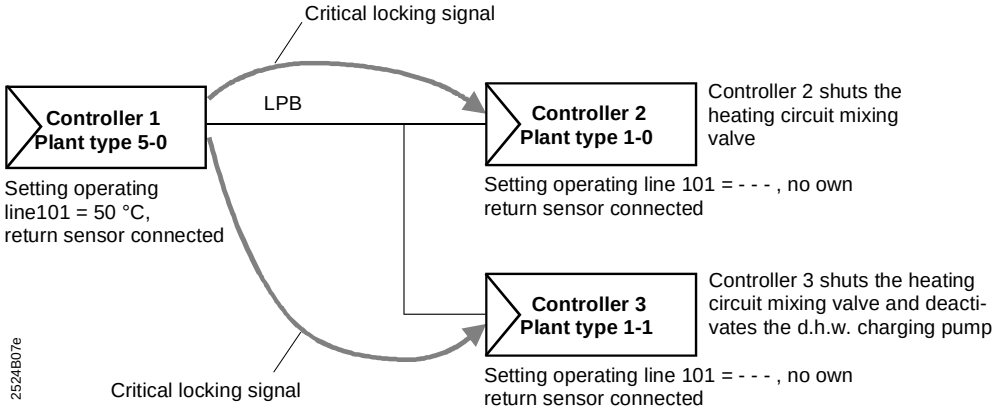
With no possibility of minimum return temperature limitation

Operating line 101 = 50 °C
return temperature sensor connected

Controller 2 generates a critical locking signal which shuts the heating circuit mixing valve and deactivates the charging pump

13.3.4 Mode of operation in interconnected plants

Central action of limitation



Setting operating line101 = 50 °C, return sensor connected

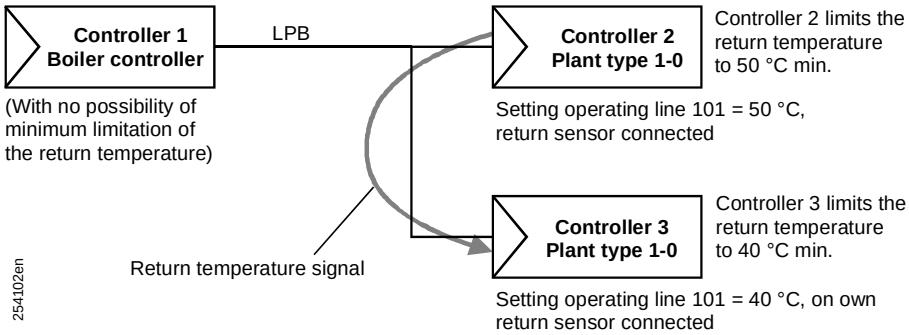
Controller 2 shuts the heating circuit mixing valve

Setting operating line 101 = - - - , no own return sensor connected

Controller 3 shuts the heating circuit mixing valve and deactivates the d.h.w. charging pump

Setting operating line 101 = - - - , no own return sensor connected

Local action of limitation



(With no possibility of minimum limitation of the return temperature)

Controller 2 limits the return temperature to 50 °C min.

Setting operating line 101 = 50 °C, return sensor connected

Controller 3 limits the return temperature to 40 °C min.

Setting operating line 101 = 40 °C, on own return sensor connected

The zone controller with its own return temperature sensor (plant type 1–x) passes the return temperature to the other zone controllers in the same segment, which can provide minimum limitation of the return temperature on a local basis, depending on the settings made. This means they generate a critical locking signal internally. For response to critical locking signals, refer to section “25.4.7 Gain of locking signal“.

14 Function block "District heat"

Together with function block "3-position actuator heating circuit", this function block provides flow temperature control in plants with an indirect (heat exchanger) or direct district heat connection.

Depending on the type of plant, if acts as a

- flow temperature controller for weather-compensated control of space heating with a district heat connection (plant type 3–x)
- precontroller for demand-compensated control of a main flow (plant type 6–x)

If the settings of this function block have been locked (contact H3, or on operating line 248; refer to the respective sections), the display shows OFF when pressing buttons − and + .

14.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
112	Slope of maximum limitation of return temperature	0.7 (0.0…40)	
113	Start of shifting limitation of maximum limitation of return temperature	10 (–50…+50)	°C
114	Integral action time of maximum limitation of return temperature	30 (0…60)	min
115	Maximum limitation of return temperature differential	--.- (--.- / 0,5…50)	°C
116	Minimum stroke limitation (Ymin function)	6 (-- / 1…20)	min

14.2 Limitations

14.2.1 Maximum limitation of the primary return temperature

Purpose

The primary return temperature uses maximum limitation to

- make certain that too hot water will not be fed back to the district heating network
- minimize piping losses of the district heating utility
- comply with the regulations of the utility

Note

The maximum limitation of the primary return temperature is inactive upon d.h.w request via data bus.

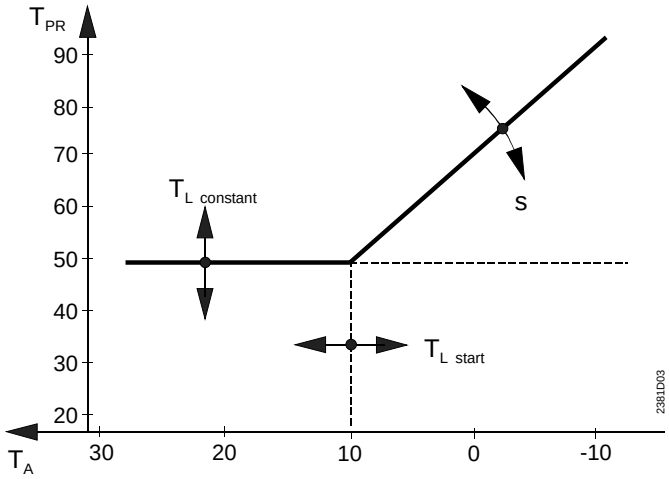
Generation of the maximum limit value

The maximum limit value is generated from the following variables:

- Constant value (setting on operating line 101)
- Slope (setting on operating line 112)
- Start of compensation (setting on operating line 113)

The current limit value can be determined as follows:

- If the outside temperature is higher than or equal to the value set for the start of compensation (setting on operating line 113), the current limit value is the constant value entered on operating line 101
- If the outside temperature is lower than the value set for the start of compensation, the current limit value is calculated according to the following formula:
  $T_L = T_{L\,constant} + [(T_{L\,start} - T_A) \times s]$ [°C]



s	Slope of limitation (operating line 112)
TA	Actual outside temperature
$T_{L\ constant}$	Constant value of limitation (operating line 101)
$T_{L\ start}$	Start of shifting limitation (operating line 113)
T_{PR}	Primary return temperature

Function

The outside temperature is used as a compensating variable for maximum limitation of the primary return temperature. It can be delivered either by the local sensor or the LPB.

Limitation operates according to the selected characteristic:

- When the outside temperature falls, the return temperature will initially be limited to the constant value
- If the outside temperature continues to fall, it will reach the selected starting point for shifting compensation. From this point, the limit value will be raised as the outside temperature falls. The slope of this section of the characteristic can be adjusted.

Maximum limitation of the return temperature has priority over minimum limitation of the flow temperature.

This function can be deactivated on operating line 101.

If the return temperature is limited, the display shows ⌜.

14.2.2 Maximum limitation of return temperature differential (DRT limitation)

Function

For the differential of primary return and secondary return temperature, a maximum limitation can be set. For this purpose, a temperature sensor (sensing element LG-Ni 1000) is required in the secondary return.

If the differential of the two return temperatures exceeds the adjusted maximum limit, the flow temperature setpoint will be reduced.

DRT limitation has priority over minimum limitation of the flow temperature.

This function can be deactivated (setting --- on operating line 115).

If DRT limitation is active, the display shows ⌜.

Action during d.h.w. heating

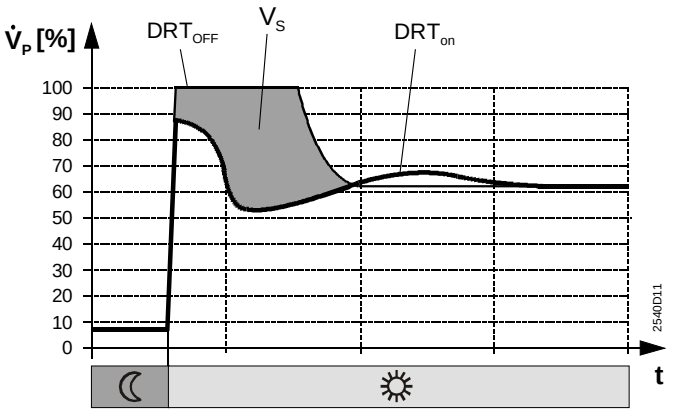
With plant types 3–1, 3–3, and 6–x, DRT limitation is not active during d.h.w. heating.

Purpose

Limitation of the return temperature differential

- prevents idle heat resulting from excessive cooling down (no unnecessary return supply of heat to the utility)
- optimizes the volumetric flow
- is a dynamic return temperature limitation
- shaves peak loads
- ensures the lowest possible return temperature

Example of the effect of maximum limitation of the return temperature differential:



DRT_{On}	Maximum limitation of return temperature differential is
DRT_{OFF}	Maximum limitation of return temperature differential is not active
t	Time
$\dot{V}_P$	Volumetric flow on the primary side
V_S	Volume saved

14.2.3 Integral action time

With maximum limitation of the return temperature and maximum limitation of the return temperature differential, the integral action time determines the rate at which the flow temperature setpoint will be reduced.

- Short integral action times lead to faster reductions
- Long integral action times lead to slower reductions

With this setting, the effect of the limitation function can be matched to the type of plant.

14.2.4 Minimum stroke limitation (suppression of hydraulic creep)

Function

To avoid measurement errors in connection with heat metering due to extremely small flow rates, the flow through the two-port valve in the primary return can be limited to a minimum (Y_{min} function). If the valve is supposed to open below the minimum stroke position, it will be fully closed and remains closed until the set closing time has elapsed. The first opening pulse after completion of the closing time will reopen the valve and the control resumes normal operation.
The stroke assigned to the minimum volumetric flow must be acquired by an auxiliary switch fitted in the actuator and delivered to the RVL481. When bridging terminals H4–M, the valve will close and the waiting time commences.
If minimum stroke limitation is active, the display shows ⌟.
Minimum stroke limitation has priority over all other limitations.

Behavior during d.h.w. heating

Minimum limitation of stroke also acts during d.h.w. heating.

14.2.5 Flow limitation

The RVL481 does not provide limitation of the volumetric flow.

15 Function block "Maximum limitation of the return temperature, d.h.w."

In plants with district heat connection, function block “Maximum limitation of the return temperature, d.h.w.” provides maximum limitation of the primary return temperature during d.h.w. heating. Since for that purpose, the primary return temperature must be acquired during d.h.w. heating, this function can only be implemented with plant types where d.h.w. is heated on the secondary side of the heating circuit’s heat exchanger (plant types 3–1, 3–3, 6–1 and 6–2).
If the settings of this function block have been locked (contact H3, or on operating line 248; refer to the respective sections), the display shows OFF when pressing buttons − and + .

15.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
117	Maximum limitation of return temperature d.h.w.	--- (--- / 0…140)	°C

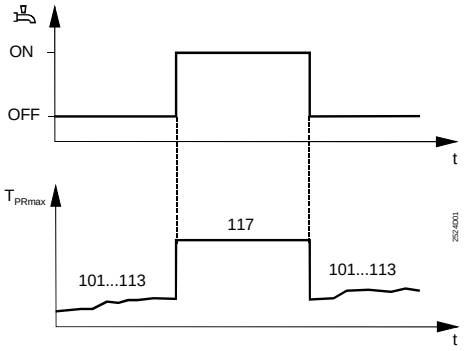
15.2 Purpose

The primary return temperature of the d.h.w. circuit has its own maximum limitation in order to

- be able to differentiate between the maximum limit value during d.h.w. heating and the limit value during space heating only
- make certain that too hot water will not be fed back to the district heating network
- minimize piping losses of the district heating utility
- satisfy the regulations of the district heating utility

15.3 Function

The maximum limit value during d.h.w. heating is set in °C on operating line 117, the integral action time for this function on operating line 114.
As soon as d.h.w. heating is started, the higher of the two values from operating lines 101…113 and 117 is used, independent of the kind of priority.
If no d.h.w. is heated, the interaction with maximum return temperature limitation looks as follows:



ON	D.h.w. heating ON
OFF	D.h.w. heating OFF
T_{PRmax}	Maximum limit value of primary return temperature
t	Time
101…113	Maximum limitation of the return temperature in the heating circuit (operating lines 101…113)
117	Maximum limitation of the return temperature in the d.h.w. circuit (operating line 117)

The return temperature is acquired with sensor B7.
This function can be deactivated on operating line 117. In that case, no maximum limitation of the return temperature is provided during d.h.w. heating.
If the function is active, the display shows ⌐ .
This maximum limitation has priority over minimum limitation of the flow temperature.

16 Function block "Basic settings d.h.w."

Function block "Basic settings d.h.w." is used to select the heating circuits for which the d.h.w. is heated and according to which program the d.h.w. circulating pump shall operate.

16.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
121	Assignment of d.h.w. heating	0 (0…2)	
122	Program for the circulating pump	2 (0…3)	

16.2 Assignment of d.h.w. heating

Operating line 121 is used to select for which heating circuits the d.h.w. is heated, that is, which heating circuits draw their water from the same source.

Operating line 121	*Explanation*
0	D.h.w. heating is only provided for the heating circuit associated with the own controller. With plant types 4–x, 5–x, and 6–x, this setting makes no sense since no own heating circuit exists (no d.h.w. in that case).
1	D.h.w. heating is only provided for the heating circuits of the controllers **with the same segment number** that are connected to the data bus (LPB).
2	D.h.w. heating is provided for **all** heating circuits of the controllers connected to the data bus (LPB).

The setting is required in connection with operating lines 122 (circulating pump program) and 123 (release of d.h.w. heating).

16.3 Program for the circulating pump

16.3.1 General mode of operation

On operating line 122, it is possible to enter according to which time program the d.h.w. circulating program shall operate. The use of a circulating pump is optional with all types of plant.

Important

With d.h.w. plant type x–4 ”Instantaneous d.h.w. heating via heat exchanger”, it is strongly recommended to use a circulating pump, the reason being better control performance.

That circulating pump runs only when d.h.w. heating is switched on (button is lit). The circulating pump runs at the following times, depending on the setting made on operating line 122:

Operating line 122	*The circulating pump runs*
0	Continuously (24 hours a day)
1	According to one or several heating programs
2	According to switching program 2 of own controller
3	According to switching program 3 of own controller

With setting 1, operation of the circulating pump depends on the setting made on operating line 121. In an interconnected plant with several controllers, that is, with several heating programs, the circulating pump runs when at least one of the controllers pro-

vides heating to the NORMAL temperature according to its heating program (independent of the operating mode) and is not in holiday mode.
The circulating pump runs with a forward shift against the times of the heating program; this means it is affected by optimum start control.
With plant types 4–x, 5–x, and 6–x and the setting of “0” (own controller) on operating line 121, the circulating pump never runs since these plant types have no own heating program.
2 examples are given below to show the behavior of the circulating pump when controllers A, B, C and D are interconnected via data bus:

Example 1

Operating line		*Controllers*	*Operating mode*	*Heating program, holidays*	*Circulating pump*
121	*122*				
2	1	A	Auto	06:00…18:00	The circulating pump runs from 06:00:00 to 23:00
		B	☾	07:00…23:00	
		C	Auto	07:00…22:00	
		D	Auto	03:00…22:00, HOLIDAYS	

Example 2

Operating line		*Controllers*	*Operating mode*	*Heating program, holidays*	*Circulating pump*
121	*122*				
2	1	A	Auto	06:00:00..0.18:00, optimum start control shifts forward by 2 hours	The circulating pump runs from 04:00:00 to 23:00
		B	☾	08:00…23:00	
		C	Auto	07:00…22:00	
		D	☼	05:00…21:00	

16.3.2 Operation of circulating pump during the holiday period

During the holiday period, the circulating pump runs according to the setting made, as shown in the following table:

Operating line 121	Operating line 122	*Operation of circulating pump*
0	0, 1, 2, or 3	Circulating pump OFF, if own controller in holiday mode
1	0, 1, 2, or 3	Circulating pump OFF, if all controllers having the same segment number are in holiday mode
2	0, 1, 2, or 3	Circulating pump OFF, if all controllers in the interconnected system are in holiday mode

16.4 Frost protection for d.h.w.

The frost protection for d.h.w. provided by the RVL481 is ensured by sensors B3, B31 and B32. The behavior depends on the type of plant.

16.4.1 Frost protection in the d.h.w. storage tank

This type of frost protection is used with plant types x–1, x–2, and x–3. It always ensures a minimum switch-on temperature of 5 °C. If the temperature acquired with sensor B31 or B32 falls below 5 °C, storage tank charging will immediately be started (independent of other settings), which generates a heat requisition to the precontroller. The switch-off temperature is at 5 °C plus the switching differential (set on operating line 128).

Important

When using thermostats, there is no frost protection for the d.h.w. storage tank.

16.4.2 Frost protection in the d.h.w. storage tank flow

This type of frost protection is used with plant types x–2.
If the d.h.w. flow temperature (acquired with sensor B3) falls below 5 °C, the charging pump starts to run. The mixing valve will not be opened and there will be no heat requisition to the precontroller.
The switch-off temperature is 6 °C.

16.4.3 Frost protection for the secondary d.h.w. flow

With plant types x–4, no frost protection for d.h.w. can be provided since it cannot be made certain that sensor B3 will acquire the temperature in the heat exchanger when d.h.w. heating is switched off (circulating pump OFF).

17 Function block "Release of d.h.w. heating"

Based on the settings made, function block "Release of d.h.w. heating" determines at what times d.h.w. heating will be released to the NORMAL d.h.w. setpoint.

17.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
123	Release of d.h.w. heating	2 (0…2)	

17.2 Release

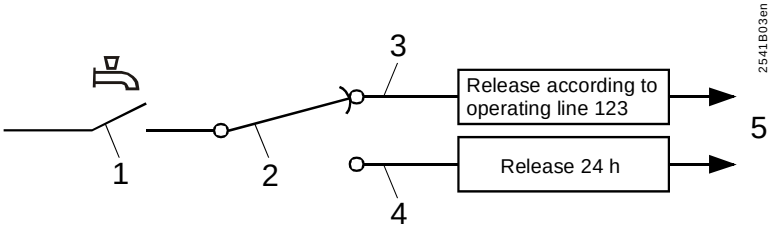
17.2.1 Function

On operating line 123, it is possible to select at what times d.h.w. heating is to be released to the NORMAL d.h.w. setpoint. Released means:

- With plants equipped with a d.h.w. storage tank (plant types x–1, x–2, and x–3): Storage tank will be recharged as needed
- With plants using instantaneous d.h.w. heating (plant type x–4): The valve in the primary return is controlled such that the required d.h.w. temperature at sensor B3 will be reached

This function makes it possible to reduce the d.h.w. temperature during nonoccupancy times to the REDUCED setpoint (at night) or to shut it down (e.g. during holiday periods).

If d.h.w. heating in the summer takes place alternately with an electric immersion heater, the latter will be released continuously – independent of the setting made on operating line 123 – that is, 24 hours a day.



Mechanism of d.h.w. heating release

1 D.h.w. button
2 Type of heating (hot water / electric immersion heater)
3 D.h.w. heating with hot water
4 D.h.w. heating with electric immersion heater
5 D.h.w. heating

With all plant types x–5, d.h.w. heating is always released as long as it is switched on.

17.2.2 Release programs

Depending on the setting made on operating line 123, release of d.h.w. heating takes place at the following times:

Setting	*D.h.w. heating is released*
0	Continuously (24 hours a day)
1	According to one or several heating programs
2	According to switching program 2 of own controller

With setting 1, d.h.w release depends on the setting made on operating line 121. In an interconnected system of several controllers, that is, in the case of several heating programs, the circulating pump runs if at least one of the connected controllers provides heating to the NORMAL temperature according to its heating program (independent of the operating mode), and is not in holiday mode.
Release of d.h.w. heating is shifted forward in time by one hour against the times of the heating program. If optimum start control is active, the optimized switch-on times are used – and not the times entered.
With plant types 4–x, 5–x, and 6–x, and the setting of 0 (own controller) on operating line 121, d.h.w. heating will never be released since these plant types have no own heating program.
The release of d.h.w. heating is explained using 2 examples, in which controllers A, B, C and D are interconnected via the data bus:

Example 1

Operating line		*Controllers*	*Operating mode*	*Heating program, optimization, holidays*	*Release*
121	*123*				
2	1	A	Auto	06:00…18:00, no optimization	D.h.w. heating is released from 04:00 to 23:00
		B	☾	07:00…23:00	
		C	Auto	07:00…22:00, optimum start control shifts forward by 2 hours	
		D	Auto	03:00…22:00, HOLIDAYS	

Example 2

Operating line		*Controllers*	*Operating mode*	*Heating program, optimization, holidays*	*Release*
121	*123*				
2	1	A	Auto	06:00…18:00, no optimization	D.h.w. heating is released from 04:00 to 23:00
		B	☾	08:00…23:00	
		C	Auto	07:00…22:00, optimum start control shifts forward by 2 hours	
		D	☼	05:00…21:00	

17.2.3 D.h.w heating during the holiday period

In holiday mode, d.h.w. heating is provided as follows:

Operating line 121	Operating line 123	*D.h.w. heating*
0	0, 1, or 2	No d.h.w. heating when own controller is in holiday mode
1	0, 1, or 2	No d.h.w. heating when all controllers in the same segment are in holiday mode
2	0, 1, or 2	No d.h.w. heating when all controllers in the interconnected system are in holiday mode

18 Function block "D.h.w. priority and flow temperature setpoint"

On this function block, the kind of d.h.w. priority (absolute, shifting, or parallel) and the generation of the common flow temperature setpoint (maximum selection, d.h.w.) are set.

18.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
124	D.h.w. priority, flow temperature setpoint	0 (0…4)	

18.2 Settings

Operating line 124	*D.h.w. priority*	*Flow temperature setpoint according to*
0	Absolute	D.h.w.
1	Shifting	D.h.w.
2	Shifting	Maximum selection
3	None (parallel)	D.h.w.
4	None (parallel)	Maximum selection

18.3 D.h.w. priority

Depending on the capacity of the heat source, it may be practical to reduce the amount of heat drawn by the heating circuit(s) during d.h.w. heating, thus ensuring that the required d.h.w. temperature will be reached more quickly. This means that d.h.w. heating is given priority over space heating.
For this purpose, the controller offers 3 types of d.h.w. priority:

- Absolute priority
- Shifting priority
- No priority (parallel operation)

In the case of plants using a changeover valve (plant types x–3), absolute priority is always present. In that case, selection of the kind of priority has no impact.
The priority is provided by delivering locking signals. The effect of the locking signals is described in section “25.4.7 Gain of locking signal".

18.3.1 Absolute priority

During d.h.w. heating, the heating circuits are locked, that is, they receive no heat.

- Controller with no bus connection:
  During d.h.w. heating, the controller sends an uncritical locking signal of 100 % to its own heating circuit
- Controller with bus connection:
  During d.h.w. heating, the controller signals the "Consumer master" that it presently provides d.h.w. charging with absolute priority. The consumer master is the unit with the same segment number as the controller with device number 1. The consumer master then sends an uncritical locking signal of 100 % to all controllers in the same segment. If the consumer master is in segment 0, the uncritical locking signal will be delivered to all controllers in all segments.

18.3.2 Shifting priority

During d.h.w. charging, the heating circuits will be throttled if the heat generating equipment (the boiler) is not able to maintain the required setpoint. In that case, the display of the boiler controller shows .

- Controller with no bus connection:
  If, during d.h.w. heating with shifting priority, the boiler is not able to maintain the setpoint, the differential between setpoint and actual value will be integrated and an integral-dependent uncritical locking signal in the range 0…100 % delivered to the own heating circuit.
  Since shifting priority is determined by the boiler, this kind of priority is only possible with plant type 2–x. With plant types 1–x and 3–x, the setting "Shifting priority" has the same impact as the setting "No priority".
- Controller with bus connection:
  During d.h.w. heating, the controller signals the heat source in the same segment (controller and heat source could be identical) that it presently provides d.h.w. heating with shifting priority. If, now, the boiler is not able to maintain its setpoint, the differential between setpoint and actual value will be integrated and an integral-dependent uncritical locking signal in the range 0…100 % generated. If the heat source is located in segment “0”, it delivers the locking signal to all controllers in all segments. If the heat source is in segment 1…14, it only sends the locking signal to the controllers in the same segment.

18.3.3 No priority

No priority means parallel operation. D.h.w. charging has no impact on the heating circuits.

18.4 Flow temperature setpoint

With "Shifting priority" and "No priority", the temperature setpoint of the common flow, which is used for both d.h.w. charging and space heating, can be generated in 2 different ways:

- Flow temperature setpoint according to the maximum selection
- Flow temperature setpoint according to the d.h.w. demand

With plant types 1–x, 3–2, and 3–4, the temperature setpoint of the common flow is transmitted to the precontroller via the data bus.
With plant types 2–x, 3–1, 3–-3, 4–x, 5–x, and 6–x, the temperature setpoint of the common flow is valid for sensor B1.
With the plant types that have no own heating circuit (4–x, 5–x, and 6–x), the heating circuit demand is transmitted to the controller via the data bus.

18.4.1 Flow setpoint according to maximum selection

In the case of d.h.w. heating, the temperature setpoint of the common flow for the d.h.w. and the heating circuit is generated from the two demands by maximum selection.

Example

It is assumed that the mixing heating circuit calls for 40 °C, the d.h.w. circuit for 65 °C. With d.h.w. charging, the setpoint of the common flow temperature will then be the higher of the 2, namely 65 °C.

18.4.2 Flow setpoint according to d.h.w.

With d.h.w. heating, the temperature setpoint of the common flow for the d.h.w. and the heating circuit is that required for the d.h.w. circuit.

Example

It is assumed that the mixing heating circuit calls for 80 °C and the d.h.w. circuit for 65 °C. With d.h.w. charging, the setpoint of the common flow temperature will then be that of the d.h.w. circuit, namely 65 °C.

19 Function block "D.h.w. storage tank"

Based on the settings made, this function block performs all d.h.w. functions required for the plant types with a d.h.w. storage tank.
With plant types x–5 (electric immersion heater only), this function block is not active (except operating line 126) since the electric immersion heater provides the functions independent of the RVL481.
The settings for solar d.h.w. heating are listed in the corresponding function block (operating lines 201…208, refer to chapter "26 Function block "D.h.w. solar charging"").

19.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
125	D.h.w. charging	0 (0…3)	
126	D.h.w. temperature sensor / control thermostat	0 (0…5)	
127	D.h.w. charging temperature boost	10 (0…50)	°C
128	Switching differential of the d.h.w. temperature	8 (1…20)	°C
129	Maximum d.h.w. charging time	60 (--- / 5…250)	min
130	Setpoint of the legionella function	--- (--- / 20…100)	°C
131	Forced charging	0 (0 / 1)	

19.2 D.h.w. charging

The type of d.h.w. charging is to be entered on operating line 125. There are 2 basic choices:

- D.h.w. charging with hot water
- D.h.w. charging alternately with hot water and the electric immersion heater

19.2.1 D.h.w. charging with hot water

The setting on operating line 125 is 0.
The d.h.w. storage tank is charged exclusively with hot water throughout the year.

19.2.2 Alternate d.h.w. charging with hot water and electricity

The setting on operating line 125 is 1, 2, or 3.
In the winter, the d.h.w. storage tank is charged with hot water from the heating system and, in the summary, with the electric immersion heater.
Changeover takes place based on the following criteria:

- Changeover from hot water charging to the electric immersion heater takes place if there has been no demand for space heating for at least 48 hours (changeover at midnight)
- Changeover from the electric immersion heater to hot water charging is effected when there is a demand for space heating. Depending on the setting made on operating line 125 (1, 2, or 3), different types of heat demand are considered for the changeover criterion:

Operating line 125	*Criterion for changeover*
1	Demand for space heating from own heating circuit
2	Demand for space heating from all controllers connected to the data bus (LPB), **having the same segment number,** including those from the own heating circuit
3	Demand for space heating from all controllers connected to the data bus (LPB), including those from the own heating circuit

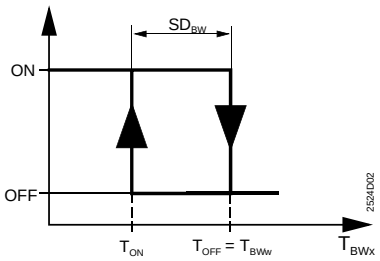
With plant types 4–x, 5–x, and 6–x, setting 1 on operating line 125 makes no sense, since there is no own heating circuit. In that case, changeover to the electric immersion heater would take place at midnight at the latest, after 48 hours of operation.

19.3 D.h.w. temperature and d.h.w. switching differential

The kind of d.h.w. storage tank temperature acquisition must be entered on operating line 126.
In plant types x–5 **without** solar heating, select setting 0, 1, 2 or 3 on operating line 126, although d.h.w. heating with electric immersion heater does not require either sensor or thermostat.
The storage temperature can be acquired via

- 1 or 2 sensors
- 1 or 2 thermostats
- 1 or 2 sensors **with** solar function; this activates function "Solar d.h.w. charging".

If temperature sensors are used, the switch-on / off temperature for charging is determined as follows:



ON D.h.w. charging ON
OFF D.h.w charging OFF
SD_{BW} Switching differential of d.h.w. charging
T_{ON} Switch-on temperature
T_{OFF} Switch-off temperature
T_{BWw} D.h.w temperature setpoint
T_{BWx} D.h.w. temperature
T_{BWx1} Measured value d.h.w. storage tank sensor B31
T_{BWx2} Measured value d.h.w. storage tank sensor B32

If the d.h.w. storage tank is equipped with thermostats, the switch-on / off temperature is determined by the thermostats.
Determination of the switch-on temperature (start of d.h.w. charging):

Operating line 126	*Measurement*	*Switching criterion*
0	1 sensor	$T_{BWx1} < (T_{BWw} – SD_{BW})$
1	2 sensors	$T_{BWx1} < (T_{BWw} – SD_{BW})$ and $T_{BWx2} < (T_{BWw} – SD_{BW})$
2	1 thermostat	Thermostat contact B31 closed
3	2 thermostats	Both thermostat contacts B31 and B32 closed
4	1 sensor, solar d.h.w. heating	$T_{BWx1} < (T_{BWw} – SD_{BW})$
5	2 sensors, solar d.h.w. heating	$T_{BWx1} < (T_{BWw} – SD_{BW})$ and $T_{BWx2} < (T_{BWw} – SD_{BW})$

Determination of the switch-off temperature (end of d.h.w. charging):

Operating line 126	*Measurement*	*Switching criterion*
0	1 sensor	$T_{BWx1} > T_{BWw}$
1	2 sensors	$T_{BWx1} > T_{BWw}$ and $T_{BWx2} > T_{BWw}$
2	1 thermostat	Thermostat contact B31 open
3	2 thermostats	Both thermostat contacts B31 and B32 open
4	1 sensor, solar d.h.w. heating	$T_{BWx1} > T_{BWw}$
5	2 sensors, solar d.h.w. heating	$T_{BWx1} > T_{BWw}$ and $T_{BWx2} > T_{BWw}$

From the 2 tables above, it is obvious that when using 2 sensors, it is irrelevant which of the 2 sensors is fitted at the top and which at the bottom of the d.h.w. storage tank.

19.4 Boost of the d.h.w. charging temperature

The boost of the d.h.w. charging temperature in °C can be set on operating line 127.
The boost refers to the setpoint of the d.h.w. temperature.
The lower the setting of this value, the longer d.h.w. charging takes.

$T_{Lw} = T_{BWw} + T_{BW\Delta}$ [°C]

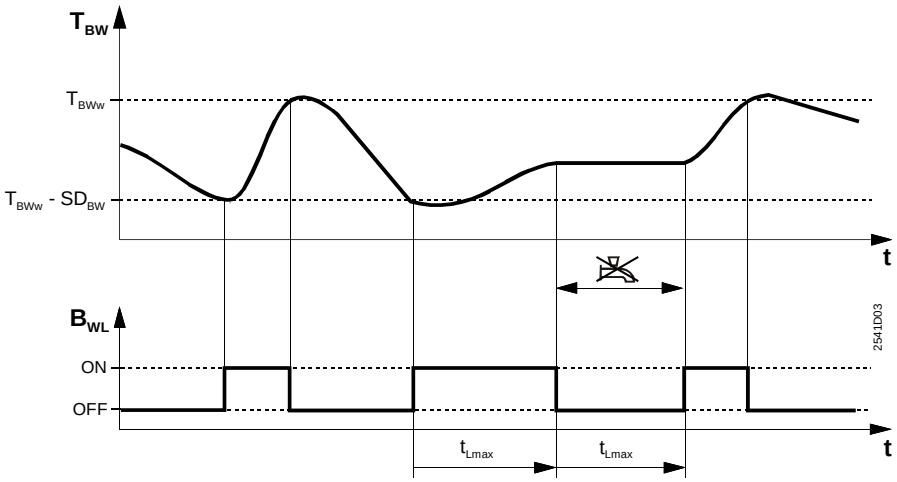
Example

Setpoint of d.h.w. temperature (T_{BWw}, operating line 26)	= 50 °C
Boost of the d.h.w. charging temperature ($T_{BW\Delta}$, operating line 127)	= 10 °C
Resulting setpoint of the charging temperature T_{Lw}	= 60 °C

If thermostats are used, the boost of the d.h.w. charging temperature must still be set.

19.5 Maximum d.h.w. charging time

The maximum charging time for d.h.w. storage tanks can be set on operating line 129.
This function is always active, independent of the kind of d.h.w. priority (absolute, shifting, or parallel).
As soon as d.h.w. charging starts, a counter records the charging time. If charging is terminated before the set maximum charging time has expired, the counter will be set to zero. A new charging cycle can commence at any time.
However, if charging takes longer than the set maximum time, charging will be stopped and than locked for the same period of time. Then, charging will be resumed either until the setpoint is reached or maximum limitation terminates the charging time again.
This function can be deactivated, in which case the charging time will not be limited.



	D.h.w. charging locked
B_{WL}	D.h.w. charging
ON	D.h.w. charging ON
OFF	D.h.w charging OFF
t	Time
t_{Lmax}	Maximum charging time
T_{BW}	D.h.w. temperature
TBWw	D.h.w temperature setpoint
SDBW	Switching differential d.h.w.

19.6 Setpoint of legionella function

On operating line 130, the setpoint of the legionella function can be adjusted or the function deactivated. This function raises the d.h.w. temperature periodically, thus making certain that legionella bacteria will be killed. For description, refer to chapter "23 Function block "Legionella function"

19.7 Forced charging

On operating line 131, it is possible to select whether or not forced charging of the d.h.w. storage tank shall take place daily when d.h.w. heating is released for the first time. With forced charging, the d.h.w. storage tank will also be charged when the d.h.w. temperature lies between the switch-on and the switch-off temperature. The switch-off point remains the same.
If d.h.w. heating is released 24 hours a day, forced charging takes place every day at midnight. If activated, the legionella function also leads to forced charging.

19.8 Protection against discharging

19.8.1 Purpose

With plant types using a d.h.w. storage tank, protection against discharging is ensured during overrun of the d.h.w. charging pump. This function makes certain that the d.h.w. will not be cooled down again during pump overrun.

19.8.2 Mode of operation

With storage tank sensor(s)

If the flow temperature is lower than the d.h.w. storage tank temperature,
- pump overrun will be terminated prematurely (plant types x–1, and x–2)
- the changeover valve will be driven to the position "Heating circuit" (plant types x–3)

If the storage tank is equipped with two sensors, the sensor measuring the higher temperature is considered.
The flow temperature is acquired with sensors B1 and B3, depending on the type of plant, or obtained from the data bus (LPB) as the common flow temperature.

With thermostat(s)

If the flow temperature is lower than the setpoint of the d.h.w. temperature,
- pump overrun will be terminated prematurely (plant types x–1, and x–2)
- the changeover valve will be driven to the position "Heating circuit" (plant types x–3)

Flow temperature

The flow temperature is ascertained as follows, depending on the type of plant and the bus connection:

Plant type	*Controller with no bus (LPB)*	*Controller with bus (LPB)*
1–1	No protection against discharging	Common flow temperature from data bus (if present), otherwise no protection against discharging
1–2	Sensor B3	Sensor B3
2–1	Sensor B1	Sensor B1
2–2	Sensor B3	Sensor B3
2–3	Sensor B1	Sensor B1
3–1	Sensor B1	Sensor B1
3–2	Sensor B3	Sensor B3
3–3	Sensor B1	Sensor B1
4–1	Sensor B1	Sensor B1
4–2	Sensor B3	Sensor B3
5–1	Sensor B1	Sensor B1
5–2	Sensor B3	Sensor B3
6–1	Sensor B1	Sensor B1
6–2	Sensor B3	Sensor B3

19.9 Manual d.h.w. charging

D.h.w. charging can be initiated manually by pressing the d.h.w. button for 5 seconds. As a confirmation, the button will flash for 5 seconds.
Manual d.h.w. charging is active also when

- d.h.w. heating is not released
- the d.h.w. temperature lies inside the switching differential
- d.h.w. heating is switched off
- d.h.w. heating is switched off due to holiday mode
- d.h.w. heating is locked because the maximum charging time has been exceeded

Manually initiated charging of the d.h.w. storage tank is stopped only if the NORMAL d.h.w. temperature setpoint is reached or if the maximum charging time is exceeded.
After manual charging, d.h.w. heating always remains switched on, irrespective of whether or not it was switched on before the manual charging.
If d.h.w. heating shall be switched off again after the manual charging, the button must be pressed again after flashing (button extinguishes).
If the d.h.w. is heated with an electric immersion heater, manual charging is not possible.

20 Function block "3-position actuator for d.h.w."

With plant types x–2 and x–4, this function block provides 3-position control of d.h.w. heating.

20.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
132	Flow temperature boost mixing valve / heat exchanger	10 (0…50)	°C
133	Actuator opening time	120 (10…873)	s
134	Actuator closing time	120 (10…873)	s
135	P-band of control (Xp)	32.0 (1…100)	°C
136	Integral action time of control (Tn)	120 (10…873)	s

20.2 Function

The 3-position controller is used for d.h.w. control (plant types x–2 and x–4).

20.2.1 Flow temperature boost

- Plant type x–2 (mixing valve):
  For the temperature demand to the precontroller / heat source, the value of operating line 132 is added to the setpoint of d.h.w. flow sensor B3.
- Plant type x–4 (heat exchanger):
  For the temperature demand to the precontroller / heat source, the value of operating line 132 is added to the setpoint of d.h.w. flow sensor B3.

20.2.2 D.h.w temperature control

The control process depends on the type of plant:

- Plant type x–2: The control mode is PI; the flow temperature is controlled by the modulating mixing valve
- Plant type x–4: The control mode is PID; the flow temperature is controlled by the modulating 2-port valve

Owing to the I-part of PI control, there is no offset. The opening and closing times of the actuator can be adjusted separately.

20.3 Pulse lock

If, during a period of time that equals 5 times the running time, the actuator has received only closing pulses, additional closing pulses delivered by the controller will be locked. This minimizes the strain on the actuator.
For safety reasons, the controller delivers a one-minute closing pulse at 10-minute intervals.
An opening pulse negates the pulse lock.

21 Function block "Derivative action time d.h.w. heating via heat exchanger"

With plant types x–4, this function block permits entry of the D-part with d.h.w. control.

21.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
137	Derivative action time of control (Tv)	16 (0…255)	s

21.2 Description

The 3-position controller provides PID mode. The derivative action time Tv (D-part) can be set on operating line 137.

A deviation of the flow temperature from the setpoint is offset by incremental adjustment of the 2-port valve. The ideal runtime of the actuator is 10…35 seconds.
In the case of d.h.w. heating via heat exchanger, it is best to set operating lines 133…137 as follows:

Operating line	*Parameter*	*Setting value*
133	Actuator opening time	35 s
134	Actuator closing time	35 s
135	P-band of control (Xp)	35 °C
136	Integral action time of control (Tn)	35 s
137	Derivative action time of control (Tv)	16 s

22 Function block "Multi-functional relay"

The RVL481 features a multifunctional relay whose function is selected on this block. This relay is also used for controlling an electric immersion heater for d.h.w. heating. This means that if the parameters of the controller are set to "Electric heater for d.h.w. only" (plant type x–5) or changeover operation, the relay cannot used for any other functions. The settings on that block are then inactive.

22.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
141	Function of multifunctional relay	0 (0…7)	
142	Manually ON / OFF	0 (0 / 1)	
143	Outside temperature switch, switch-off value for occupancy time	5.0 (–35…+35)	°C
144	Outside temperature switch, switch-off value for non-occupancy time	–5.0 (–35…+35)	°C
145	Outside temperature switch, switching differential	3 (1…20)	°C
146	Selection time switch	3 (1…3)	

22.2 Functions

The following eight functions can be assigned to the multi-functional relay:

Operating line 141	*Function*
0	No function
1	Outside temperature switch
2	ON / OFF according to the time switch
3	Relay energized in the event of fault
4	Relay energized during occupancy time according to the heating program (with no optimization)
5	Relay energized during occupancy time according to the heating program (including optimizations)
6	Relay energized, if there is demand for heat
7	Manually ON / OFF

22.2.1 No function

No function is assigned to the multifunctional relay.

22.2.2 Outside temperature switch

Using the outside temperature switch, any pieces of equipment can be controlled depending upon the outside temperature. This function requires an outside sensor or an outside temperature signal that is delivered via the data bus.
2 different switch-off values can be set for both the occupancy and non-occupancy time (operating lines 143 and 144). The switch-on point lies below the switch-off point, the difference being the set switching differential (operating line 145). Depending on the setting made on operating line 146, the occupancy and nonoccupancy times may be those of

- the heating program (setting “0”)
- switching program 2 (setting “1”)
- switching program 3 (setting “2”)

With plant types that do not have their own heating circuit (4–x, 5–x, and 6–x), the setting "Occupancy or non-occupancy time according to the heating program" makes no sense, since these types of plant have no heating program. In that case, the multifunctional relay is always de-energized.

22.2.3 ON / OFF according to the time switch

The multifunctional relay is energized and deenergized according to the time switch entered on operating line 146.
With the plant types that do not have their own heating circuit (4–x, 5–x, and 6–x), the setting "According to the heating program" makes no sense, since these types of plant have no heating program. In that case, the multifunctional relay is always de-energized.

22.2.4 Relay energized in the event of fault

If, at the RVL481, a fault status message is present, either from the controller itself or from the data bus (LCD displays 🔔), the multifunctional relay will be energized. Switching on takes place with a delay of two minutes. When the fault is corrected, that is, when the fault status is no longer present, the relay will be de-energized with no delay.

22.2.5 Relay energized during occupancy time

If the own heating circuit is maintained at operational level ☼ – independent of the operating mode – the multifunctional relay is energized. In operating mode Auto🕘, no consideration is given to optimum start / stop control.
With the plant types that do not have their own heating circuit (4–x, 5–x, and 6–x), the setting "Relay energized during occupancy time" makes no sense. In that case, the multifunctional relay is always de-energized.

22.2.6 Relay energized during occupancy time (including optimizations)

If the own heating circuit is maintained at operational level ☼ – independent of the operating mode – the multi-functional relay is energized (LCD displays ☼). In operating mode Auto🕘, consideration is given to optimum start / stop control.
With the plant types that do not have their own heating circuit (4–x, 5–x, and 6–x), the setting "Relay energized during occupancy time" makes no sense. In that case, the multifunctional relay is always de-energized.

22.2.7 Relay energized, if there is demand for heat

If the own heating circuit or the d.h.w. circuit calls for heat, the multi-functional relay will be energized. In interconnected plants, the relay is energized when the controller receives a demand for heat.

22.2.8 Manually ON / OFF

On operating line 142, the multifunctional relay can be manually energized and de-energized with the setting buttons.

Press button	*Effect*
+	Multifunctional relay will be energized
−	Multifunctional relay will be de-energized

23 Function block "Legionella function"

In the case of d.h.w. heating systems with storage tanks, this function prevents the formation of legionella bacteria. This is accomplished by periodically heating the d.h.w. to a certain temperature level.

23.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
147	Periodicity of the legionella function	1 (0…7)	
148	Time of legionella function	05:00 (00:00…24.00)	hh:mm
149	Dwelling time at legionella setpoint	30 (0…360)	min
150	Circulating pump operation during the legionella function	1 (0 / 1)	

23.1.1 Periodicity of legionella function

The periodicity is displayed on operating line 147.

- Setting 0 ensures that d.h.w. heating to the legionella setpoint takes place once a day
- Settings 1 through 7 ensure that d.h.w. heating to the legionella setpoint takes place once a week. Setting 1 means every week on Monday, setting 2 every week on Tuesday, etc.

23.1.2 Time of legionella function

The time of day the legionella function shall be activated can be set on operating line 48.

23.1.3 Dwelling time at the legionella setpoint

Operating line 149 is used to determine for what period of time the actual d.h.w. temperature must lie above the legionella setpoint (operating line 130) to satisfy the requirement of this function.

23.1.4 Circulating pump operation during the legionella function

Operating line 150 can be used to select whether the legionella function shall act on the d.h.w. circulating pump.

- When choosing “0”, the legionella function does not act on the d.h.w. circulating pump
- When choosing “1”, the legionella function acts on the d.h.w. circulating pump

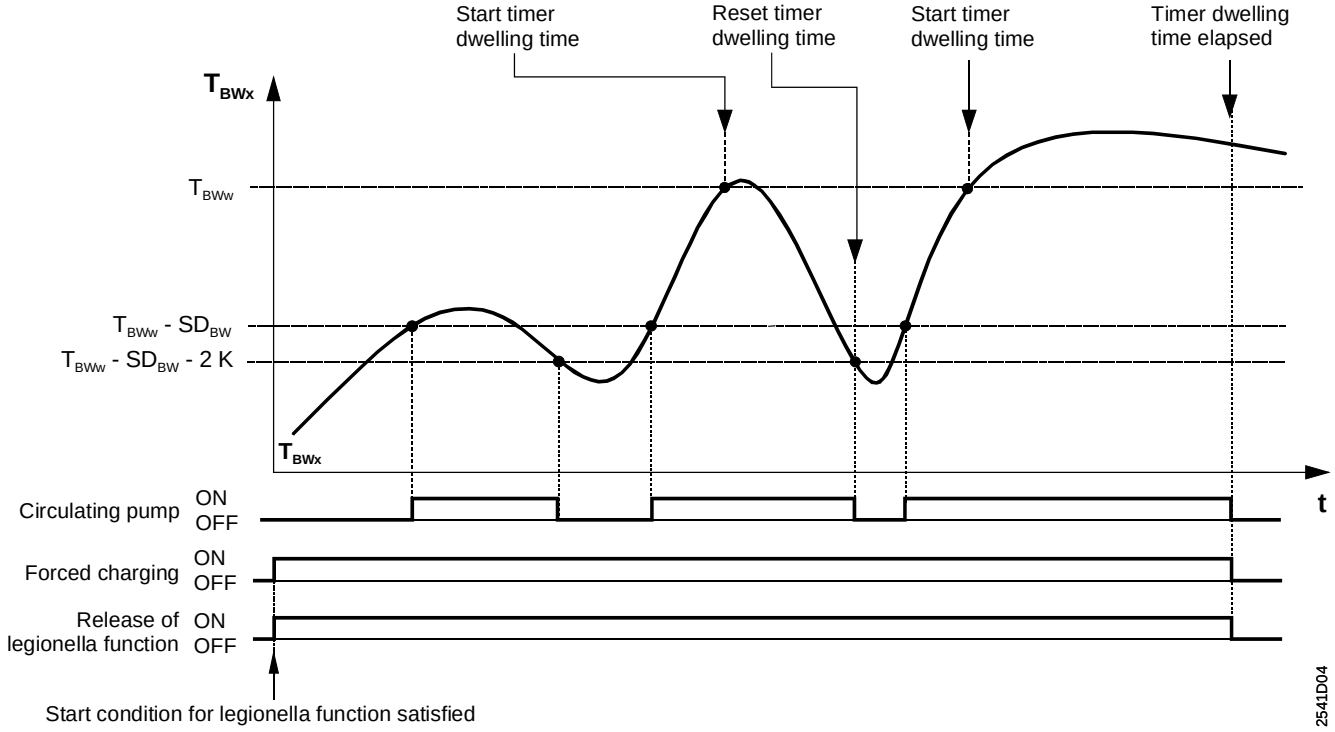
23.2 Mode of operation

Preconditions for the legionella function:

- The d.h.w. storage tank temperature is acquired with one or 2 sensors (the legionella function is not possible with thermostats)
- Charging takes place instantaneously with the heating water and not with the electric immersion heater
- A legionella setpoint is adjusted
- D.h.w. heating is switched on (button lit)
- The holiday function and operating mode changeover via contact H1 are not active

When the periodicity and time criteria are satisfied, the legionella function will be released. Release of the legionella function means that the d.h.w. temperature setpoint will be raised to the legionella setpoint and forced charging is enabled. If d.h.w. heating is switched off or the holiday function or operating mode changeover active, the legionella function will be released, but not the setpoint boost. On termination of the overriding function, d.h.w. heating to the legionella setpoint will again be triggered since the legionella function is still released.

The behavior of the legionella function as a function of the d.h.w. temperature is as follows:



TBWx	D.h.w. temperature
TBWw	D.h.w temperature setpoint
SDBW	Switching differential of d.h.w. charging
t	Time

If a maximum d.h.w. charging time is set, it also acts here. If the legionella setpoint is not reached, the legionella function is interrupted and resumed at the end of the maximum charging time.

24 Function block "Switching program 3"

Switching program 3 of this function block can be used for one or several of the following functions:

- As a time switch program for the circulating pump (operating line 122)
- As a time switch program for the multifunctional relay (operating lines 141 and 146)

24.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
151	Weekday for switching program 3	1-7 (1…7, 1-7)	
152	Start of first ON period	06:00 (--:-- / 00:00…24:00)	hh:mm
153	End of first ON period	22:00 (--:-- / 00:00…24:00)	hh:mm
154	Start of second ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
155	End of second ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
156	Start of third ON period	--:-- (--:-- / 00:00…24:00)	hh:mm
157	End of third ON period	--:-- (--:-- / 00:00…24:00)	hh:mm

24.2 Function

Switching program 3 of the RVL481 affords a maximum of 3 ON periods per day. Also, every day of week may have different ON periods.
As with the heating program, it is not switching times that are entered, but periods of time during which the program or the controlled function shall be active.
Using the setting "1-7" on operating line 151, it is possible to enter a heating program that applies to all days of the week. This simplifies the settings: If the weekend times differ, enter the times for the entire week first, and then change days 6 and 7 as required.
The entries are sorted and overlapping ON periods combined.

25 Function block "Service functions and general settings"

Function block "Service functions and general settings" is used to combine various displays and setting functions that are of assistance in connection with commissioning and service work. In addition, a number of extra functions are performed.
The service functions are independent of the type of plant.

25.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
161	Outside temperature simulation	--.- (--.- / –50…+50)	°C
162	Relay test	0 (0…10)	
163	Sensor test	Display function	
164	Test of H–contacts	Display function	
165	Flow temperature setpoint	Display function	
166	Resulting heating curve	Display function	
167	Outside temperature for frost protection for the plant	2.0 (--.- / 0…25)	°C
168	Flow temperature setpoint for frost protection for the plant	15 (0…140)	°C
169	Device number	0 (0…16)	
170	Segment number	0 (0…14)	
171	Flow alarm	--:-- (--:-- / 1:00…10:00)	hh:mm
172	Operating mode when terminals H1–M are bridged	0 (0…9)	
173	Gain of locking signal	100 (0…200)	%
174	Pump overrun time	6 (0…40)	min
175	Pump kick	0 (0 / 1)	
176	Winter- / summertime changeover	25.03 (01.01…31.12)	dd:MM
177	Summer- / wintertime changeover	25.10 (01.01…31.12)	dd:MM
178	Clock mode	0 (0…3)	
179	Bus power supply	A (0 / A)	
180	Outside temperature source	A (A / 00.01…14.16)	
181	DC 0…10 V heat demand output U_X	130 (30…130)	°C
194	Hours run counter	Display function	
195	Controller's software version	Display function	
196	Identification code of room unit	Display function	

25.2 Display functions

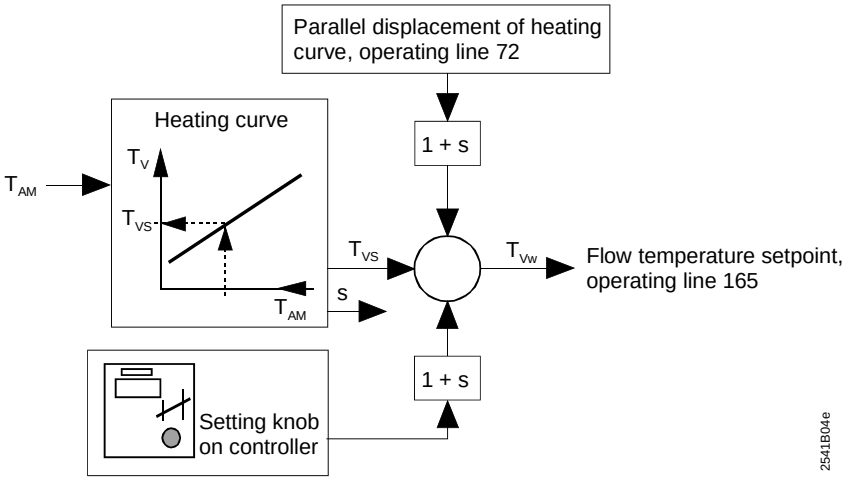
25.2.1 Flow temperature setpoint

Displayed is the current flow temperature setpoint which is made up of the following variables:

- Flow temperature setpoint in function of the composite outside temperature and the heating curve
- Position of the knob for room temperature readjustments
- Parallel displacement (setting on operating line 72)

With demand-compensated control (plant types 4–x, 5–x, and 6–x), the display shows ---.

Generation of the flow temperature setpoint



s Slope
T_{AM} Composite outside temperature
T_{VS} Flow temperature setpoint (generated via the heating curve)
TVw Flow temperature setpoint

25.2.2 Heating curve

The display shows the resulting heating curve which is composed of the following variables:

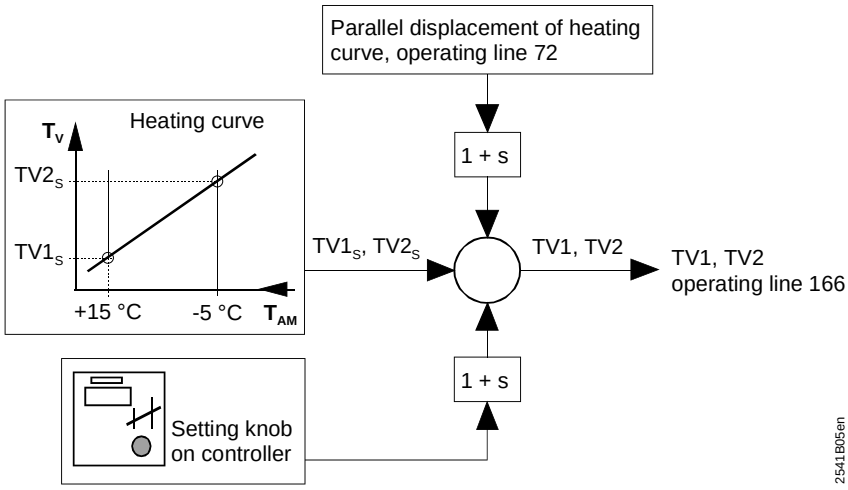
- Basic setting with the little bar or on operating lines 14 and 15
- Position of the knob for room temperature readjustments
- Parallel displacement (setting on operating line 72)

The display also shows the 2 flow temperature setpoints:

- TV1; current setpoint at an outside temperature of +15 °C
- TV2; current setpoint at an outside temperature of –5 °C

With demand-compensated control (plant types 4–x, 5–x, and 6–x), the display shows --- --- .

Display of heating curve data



s Slope
TV1 Actual flow temperature setpoint at +15 °C
TV2 Actual flow temperature setpoint at –5 °C
TV…S Flow temperature setpoint (generated via the heating curve)

25.2.3 Hours run counter

The number of controller operating hours is displayed. Whenever operating voltage is present, the RVL481 counts the hours.
The maximum reading is limited to 500,000 hours (57 years).

25.2.4 Software version

The controller displays the software version in use.

25.2.5 Identification number of room unit

Based on the number shown in the display, the type of room unit used can be identified. The types of room units that can currently be used with the RVL472 carry the following numbers:
82 = QAW50
83 = QAW70
The RVL481 ignores room units that cannot be used (e.g. QAW20) and generates an error message (error code 62).

25.3 Commissioning aids

25.3.1 Simulation of the outside temperature

To facilitate commissioning and fault tracing, outside temperatures in the range –50 to +50 °C can be simulated. This simulation has an impact on the actual, the composite and the attenuated outside temperature.

Simulated T_A = actual T_A = composite T_A = attenuated T_A

During the temperature simulation, the actual outside temperature (as acquired by the sensor or via LPB) will be overridden.
When the simulation is terminated, the actual outside temperature will gradually readjust the composite and the attenuated temperatures to their correct values. The simulation of the outside temperature causes therefore a reset of the attenuated and the composite outside temperatures.
There are 3 choices to terminate the simulation:

- Entry of --.-
- Leaving the setting level by pressing the Info button or any of the operating mode buttons
- Automatically after 30 minutes

25.3.2 Relay test

The eight output relays can be individually energized. Depending on the type of plant, the following codings apply:

Input	*Plants with a valve, plant types 1–x, 3–x, 4–x, and 6–x*	*Plants with a burner, plant types 2–x, and 5–x*
0	Normal operation	Normal operation
1	All contacts open	All contacts open
2	Heating circuit valve OPEN (Y1)	Burner stage 1 ON (K4)
3	Heating circuit valve CLOSED (Y2)	Burner stages 1 and 2 ON
4	Heating circuit pump / circulating pump ON (M1)	Heating circuit pump / circulating pump ON (M1)
5	Charging pump / changeover valve ON (M3/Y3)	Charging pump / changeover valve ON (M3/Y3)
6	Circulating pump ON (M4)	Circulating pump ON (M4)
7	Multifunctional relay energized (K6)	Multifunctional relay energized (K6)
8	D.h.w. valve OPEN (Y7)	D.h.w. valve OPEN (Y7)
9	D.h.w. valve CLOSED (Y8)	D.h.w. valve CLOSED (Y8)
10	Collector pump ON (M5)	Collector pump ON (M5)

There are 4 choices to terminate the relay test:

- Entry of 0 on the operating line
- Leaving the setting level by pressing button ⌓ or ⌔
- Leaving the setting level by pressing the Info button or any of the operating mode buttons
- Automatically after 30 minutes

25.3.3 Sensor test

The connected sensors can be checked on operating line 163. In addition, if available, the current setpoints and limit values are displayed.
On the display, the current setpoints are identified by SET, the actual values by ACTUAL (also refer to chapter “29 Handling”)
The 9 temperatures can be called up by entering 0…8:

Input	*Display SET*	*Display ACTUAL*
0	No display	Actual value of outside sensor at terminal B9. If the outside temperature is delivered via the data bus, the display shows ---
1	Setpoint of flow / boiler temperature. With the plant types using a boiler, the switch-off point is displayed. If there is no demand for heat, the display shows ---	Actual value of flow / boiler temperature sensor at terminal B1
2	Setpoint of room temperature. With the plant types with no heating circuit, the display shows ---	Actual value of room temperature sensor at terminal B5
3	Setpoint of room temperature. With the plant types with no rooms, the display shows ---	Actual value of room unit sensor at terminal A6
4	Limit value of return temperature. With plant types 1–x, 4–x, and 5–x, the minimum limit value of the return temperature is displayed; with plant types 3–x and 6–x, the maximum limit value of the return temperature. If no return temperature limitation is used, the display shows ---	Actual value of return temperature sensor at terminal B7. If the return temperature is delivered via data bus, the display shows ---
5	Limit value of return temperature differential. If no DRT limitation is used, the display shows ---	Actual value of the secondary return temperature sensor at terminal B71
6	Setpoint of d.h.w. flow temperature. With plant types with no d.h.w. flow, the display shows ---	Actual value of the d.h.w. flow temperature sensor at terminal B3
7	Setpoint of d.h.w. temperature. With plant types with no storage tank, the display shows ---	Actual value of the storage tank temperature sensor / thermostat at terminal B31
8	Setpoint of d.h.w. temperature. With plant types with no storage tank, the display shows ---	Actual value of the storage tank temperature sensor / thermostat at terminal B32
9	Actual value storage tank temperature B32	Actual value of the temperature at the collector, terminal B6

Faults in the measuring circuits are displayed as follows:

000 = short-circuit (thermostat: contact closed)

- - - = open-circuit (thermostat: contact open)

25.3.4 Test of H–contacts

The connected H–contacts can be checked on operating line 164. It is always the current status that is indicated (contact open, contact closed).
The contacts can be individually selected by pressing − and +.

Input	*Contact*
H1	Overriding the operating mode (contact H1)
H3	Operating lock (contact H3)
H4	Minimum limitation of stroke (contact H4)

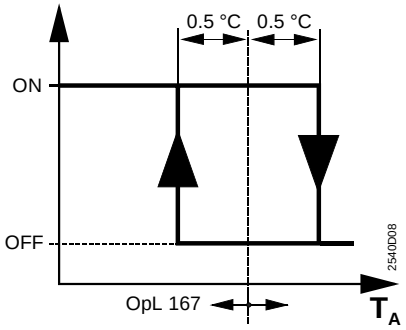
The contact's status is displayed as follows:
000 = contact closed
- - - = contact open

25.4 Auxiliary functions

25.4.1 Frost protection for the plant

The plant can be protected against frost. For this purpose, the RVL481 and the heat source equipment must be ready to operate (mains voltage present!).
The following settings are required:

- The outside temperature at which frost protection shall respond
- The minimum flow temperature that shall be maintained by the frost protection function



OpL167 Operating line 167
TA Outside temperature
OFF Frost protection OFF
ON Frost protection ON

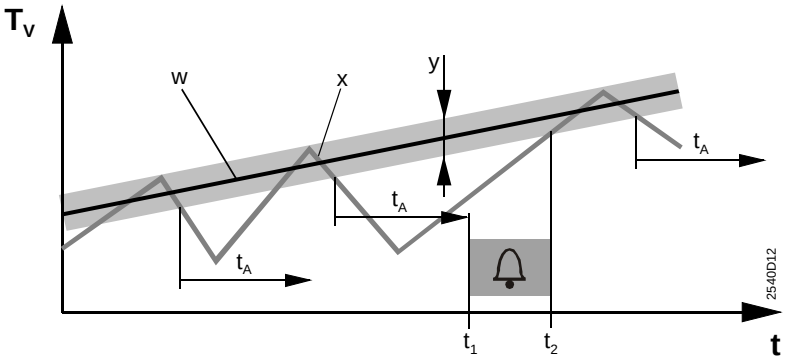
If the outside temperature falls below the limit value (setting on operating line 167 minus 0.5 °C), the RVL481 will switch the circulating pump on (pump connected to terminal Q1) and maintain the flow temperature at the selected minimum level.
The control is switched off when the outside temperature exceeds the limit value by 0.5 °C.
Frost protection for the plant can be deactivated.

25.4.2 Flow alarm

The fault alarm triggers an error message if the flow or boiler temperature does not reach the required setpoint band (setpoint ± a defined switching differential) within a defined period of time – provided there is a demand for heat. This period of time can be set on operating line 171.

- Plant type 1–x, 3–x, 4–x and 6–x: Decisive is the temperature acquired by sensor B1. The switching differential corresponds to the neutral zone (±1 °C)
- Plant types 2–x and 5–x: Decisive is the temperature acquired by sensor B1. The switching differential corresponds to the adjusted switching differential of the boiler (± 0.5 × SD; operating line 94)

The display shows the fault status message with 🔔. More detailed information is given on operating line 50 under error code 120.
The flow alarm can be deactivated by entering --:--.



t Time
t_1 Start of fault display
t_2 End of fault display
t_A Waiting time (set on operating line 171)
TV Flow temperature
w Setpoint
x Actual value
Y Setpoint band

- At t_1, error message is triggered; during the period of time t_A (set on operating line 171), the actual value stayed below the setpoint band y
- At t_2, the error message is reset; the actual value “x” has reached the setpoint band “y”

25.4.3 Manual overriding of operating mode (contact H1)

Using a simple remote operation facility, the operating mode of the heating circuit and that of d.h.w. can be overridden. This is accomplished by bridging terminals H1–M.
It is possible to select the operating mode to be used when H1–M are bridged:

Setting	*Operating mode heating circuit*		*Operating mode d.h.w.*
0	⌂	Protection	OFF
1	Auto 🕘	AUTO	OFF
2	☾	REDUCED	OFF
3	☼	NORMAL	OFF
4	⌂	Protection	ON
5	Auto 🕘	AUTO	ON
6	☾	REDUCED	ON
7	☼	NORMAL	ON
8	Auto 🕘	AUTO	ON (24 hours a day)
9	☼	NORMAL	ON (24 hours a day)

As long as this function is active, the LED of the respective operating mode button flashes at a low frequency (approx. 0.5 Hz). The buttons themselves are however inoperable.
Once this function is deactivated, the RVL481 will resume the operating mode previously selected.
With plant types 4–x, 5–x, and 6–x, contact H1 only acts on the d.h.w. circuit.

25.4.4 Pump overrun

To prevent heat from building up, a common pump overrun time can be set for all pumps associated with the controller (with the exception of the circulating pump) on operating line 174. In that case, the pumps will overrun for the overrun time set, or the changeover valve will maintain the charging position during that period of time.

D.h.w. discharging protection has priority over pump overrun.
In interconnected plants, the time set also affects the forced signals that a boiler can deliver to ensure overtemperature protection.
For detailed information, refer to section “12.4.5 Protection against boiler overtemperatures”.

25.4.5 Pump kick

To prevent pump seizing during longer off periods (e.g. in the summer), it is possible to activate periodic pump runs: The input is either “0” or “1”:
0 = no periodic pump kick
1 = periodic pump kick activated
If the pump kick is activated, all pumps run for 30 seconds, one after the other, every Friday morning at 10:00, independent of all other functions and settings.
With plant types 2–1, 2–2, and 3–1, pump Q1 is kicked only when, at the same time, charging pump Q3 does not operate.

25.4.6 Winter- / summertime changeover

The change from wintertime to summertime, and vice versa, is made automatically. If international regulations change, the dates need to be re-entered. The entry to be made is the earliest possible changeover date. The weekday on which changeover occurs is always a Sunday.

Example

If the start of summertime is given as "The last Sunday in March", the earliest possible changeover date is March 25. The date to be entered on operating line 176 is then 25.03.

If no summer- / wintertime changeover is required, the two dates are to be set such that they coincide.

25.4.7 Gain of locking signal

Fundamentals

The functions "Maintained boiler return temperature", "Protective boiler start-up" and "D.h.w. priority" use locking signals that are sent to the heat exchangers and loads.
With the heat convector and load controllers, it is possible to set on operating line 173 (amplification of locking signal) to what degree they shall respond to a locking signal.
This gain of the locking signal is adjustable from 0 % to 200 %.

Setting	*Response*
0 %	Locking signal will be ignored
100 %	Locking signal will be adopted 1:1
200 %	Locking signal will be doubled

There are 2 types of locking signals:
- Uncritical locking signals
- Critical locking signals

The response of the loads depends on the kind of load.

Uncritical locking signals

Uncritical locking signals are generated in connection with the d.h.w. priority (absolute and shifting) and only act on the heating circuits.
The response of the heating circuit depends on the type of heating circuit:
- Heating circuit with mixing valve:
  In the heating circuit, the flow temperature setpoint will be reduced as a function of the set locking signal gain. The mixing valve closes.
- Heating circuit with pump:
  In case of a defined value of the uncritical locking signal, the heating circuit pump will be deactivated, independent of the set locking signal gain. In plants with changeover valve, the valve assumes the "D.h.w.” position

Critical locking signals

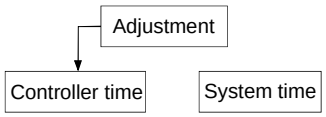
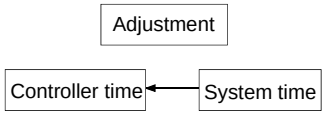
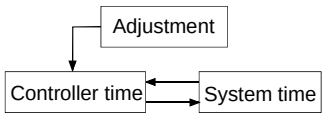
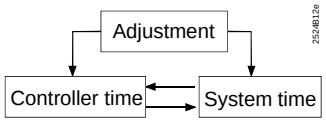
Critical locking signals are generated by the boiler temperature controller during protective boiler startup and during minimum limitation of the boiler return temperature. If the boiler temperature controller is located in segment 0, the critical locking signal will be sent to all loads and heat exchangers in the bus network and – if present – to its own heating and d.h.w. circuit. If the boiler temperature controller is in segment 1…14, it will deliver the critical locking signal only to all loads in the same segment and – if present – to its own heating and d.h.w. circuit.
Minimum limitation of the return temperature can also be provided locally by a controller with plant type no. 1–x. In that case, the critical locking signal only acts inside the controller and is only delivered to the own heating and d.h.w. circuit. With regard to the response of the consumers and heat converters, there are two choices:

- Heat converters and consumers with mixing valves:
  The flow temperature setpoint will be reduced as a function of the set locking signal gain. Heat exchanger and load close their mixing valve.
- Consumers with pump circuit:
  When a defined value of the critical locking signal is reached, the pump will be deactivated, independent of the set locking signal gain In plants with changeover valve, the valve assumes the "Heating circuit" position

25.5 Entries for LPB

25.5.1 Source of time of day

Depending on the master clock, different sources for the time of day can be used. The source must be entered on the RVL481, on operating line 178, using setting 0…3:
0 = autonomous clock in the RVL481
1 = time of day from the bus; clock (slave) with no remote readjustment
2 = time of day from the bus; clock (slave) with remote readjustment
3 = time of day from the bus; central clock (master)
The effect of the individual entries is as follows:

Input	*Effect*	*Diagram*
0	• The time of day on the controller can be readjusted • The controller's time of day is not matched to the system time	
1	• The time of day on the controller cannot be readjusted • The controller's time of day is automatically and continually matched to the system time	
2	• The time of day on the controller can be readjusted and, at the same time, readjusts the system time since the change is adopted by the master • The controller's time of day is nevertheless automatically and continually matched to the system time	
3	• The time of day on the controller can be readjusted and, at the same time, readjusts the system time • The controller time is used as a pre-setting for the system	

In each system, only one controller may be used as a master. If several controllers are set as masters, a fault status signal will be delivered (error code 100).

25.5.2 Outside temperature source

If, in interconnected plants, the outside temperature is delivered via the bus, the temperature source can be addressed either automatically or directly (operating line 180).

- Automatic addressing:

Display, entry		*Explanation*
SET	A	(For automatic addressing)
ACTUAL	xx.yy	Display of source address selected by automatic addressing: xx = segment number yy = device number

- Direct addressing:
  To be entered is the source address: xx.yy
  xx = segment number
  yy = device number

If the controller is operated autonomously (with no bus), there will be no display and no entry can be made.

If the controller is used in an interconnected plant **and** if it has its own outside sensor, it is not possible to enter an address (if an entry is made, the display shows OFF). In that case, the controller always uses the outside temperature signal delivered by its own sensor. The address displayed is its own.

For detailed information about addressing the outside temperature source, refer to Data Sheet N2030.

25.5.3 Addressing the devices

Each device connected to the data bus (LPB) requires an address. This address is comprised of a device number (1…16, operating line 169) and a segment number (0…14, operating line 170).

In an interconnected plant, each address may be assigned only once. If this is not observed, proper functioning of the entire plant cannot be ensured. In that case, a fault status signal will be generated (error code 82).

If the controller is operated autonomously (with no bus), the device number must be set to zero.

Since the device address is also associated with control processes, it is not possible to use all possible device addresses in all types of plant:

Plant type	*G = 0* *S = any (no bus)*	*G = 1* *S = 0*	*G = 1* *S = 1…14*	*G = 2…16* *S = any*
1–x	Permitted	Permitted	Permitted	Permitted
2–x	Permitted	Permitted	Permitted	Not permitted
3–0, 3–2, 3–4, 3–5,	Permitted	Permitted	Permitted	Permitted
3–1, 3–3	Permitted	Not permitted	Permitted *	Not permitted
4–x	Not permitted	Permitted	Permitted	Not permitted
5–x	Not permitted	Permitted	Permitted	Permitted
6–x	Not permitted	Permitted	Permitted	Not permitted

G = device number
S = segment number
* No other controller may be addressed in the same segment!

If an inadmissible address has been entered, an error message will appear (error code 140).

For detailed information about the addressing of devices, refer to Data Sheet N2030.

25.5.4 Bus power supply

In interconnected plants with a maximum of 16 controllers, the bus power supply may be decentralized, that is, power may be supplied via each connected device. If a plant contains more than 16 devices, a central bus power supply is mandatory.
On each connected device, it is then necessary to set whether the data bus is powered centrally or decentrally by each controller.
With the RVL481, this setting is made on operating line 179. The display shows the current setting as SET and the current bus power supply status as actual.

Display		*Bus power supply*
SET	0	Bus power supply is central (no power supply via controller)
SET	A	Bus power supply is decentral via the controller
ACTUAL	0	Presently no bus power supply available
ACTUAL	1	Bus power supply presently available

The word BUS appears on the display only when the bus address is valid and when bus power supply is available. This means the display indicates whether or not data traffic via the data bus is possible.

25.5.5 Bus loading number

The bus loading figure E for the LPB of the RVL481 is 7. The total of all E-numbers of the devices connected to the same bus may not exceed the limit of 300.

25.6 Heat demand output DC 0…10 V

Using the DC 0…10 V heat demand signal (terminals Ux–M), the RVL481 can transmit the heat demand to other devices.
The heat demand corresponds to the heat requisition in °C and – in terms of value – is identical with the heat requisition that reaches the precontroller via the data bus (LPB).
The temperature value of the heat demand corresponding to 10 V can be set via operating line 181.
Voltage signals:

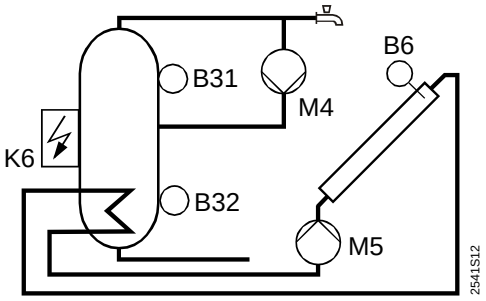
Voltage	*Temperature when operating line 181 = 80 °C*	*Temperature when operating line 181 = 130 °C*
DC 0 V	0 °C	0 °C
DC 5 V	40 °C	65 °C
DC 10 V	80 °C	130 °C

26 Function block "D.h.w. solar charging"

The RVL481 supports solar d.h.w. heating with the d.h.w. plant types 1, 2, 3 and 5. The function is activated on operating line 126 by selecting the d.h.w. temperature sensor. This always enables solar d.h.w. charging, carried out via the collector pump based on the temperature differential between d.h.w. storage tank and collector temperature.
The lower storage tank sensor B32 is used for solar charging control. If the sensor is missing, the upper storage tank sensor B31 is used automatically (if available).
Symbol ☼ on the displays indicates solar d.h.w. charging.

Note

In the event of boiler support for solar d.h.w. heating, select setting 4 (1 sensor with solar) on operating line 126 and still connect both storage tank sensors. This results in solar d.h.w. charging based on the lower sensor (B32), and boiler support via the upper sensor (B31). As a result, only the upper portion of the storage tank is charged via boiler.



B31 Storage tank sensor 1
B32 Storage tank sensor2
B6 Collector sensor
K6 Electric immersion
M4 Circulation pump
M5 Collector pump

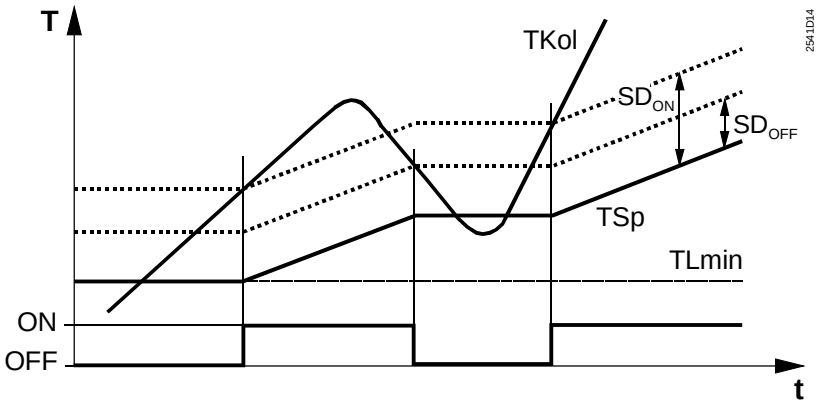
26.1 Operating lines

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
201	Temperature differential ON solar	8 (0…40)	°C
202	Temperature differential OFF solar	4 (0…40)	°C
203	Collector frost protection	--- (--- / –20…5)	°C
204	Collector over temperature protection	105 (--- / 30…260)	°C
205	Evaporation heat carrier	140 (--- / 60…260)	°C
206	D.h.w. charging temperature maximum limitation	80 (8…100)	°C
207	D.h.w. storage tank temperature maximum limitation	90 (8…100)	°C
208	Collector start function gradient	--- (--- / 1…20)	min/°C

26.2 Functions

26.2.1 Temperature differential ON/OFF solar

Operating lines 201 and 202 allow for setting the temperature differential to enable or disable solar d.h.w. charging.
A sufficiently large temperature differential between collector and d.h.w. storage tank must exist for storage tank charging; in addition, the collector must have reached a minimum charging temperature.

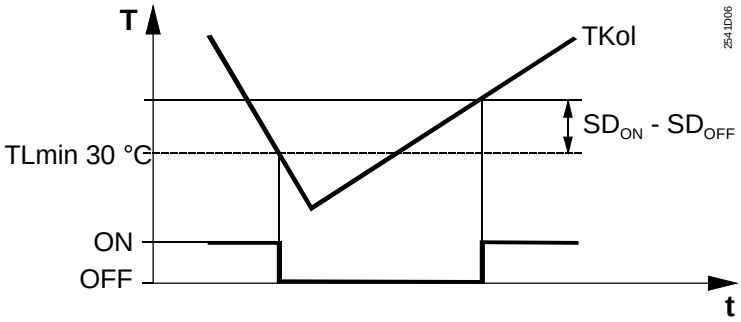


TKol	Collector temperature
ON/OFF	Collector pump
SD_{ON}	Temperature differential ON
SD_{OFF}	Temperature differential OFF
TSp	Storage tank temperature
TLmin	Minimum charging temperature
T	Temperature
t	Time

- The storage tank is charged if the collector temperature exceeds the current storage temperature by the switch-on differential:
  $TKol > TSp + SD_{ON}$
- Storage tank charging is stopped if the collector temperature drops below the temperature differential:
  $TKol < TSp + SD_{OFF}$

26.2.2 Minimum charging temperature

The collector pump is commissioned only if the collector has a minimum temperature of 30 °C and the required temperature differential is reached.

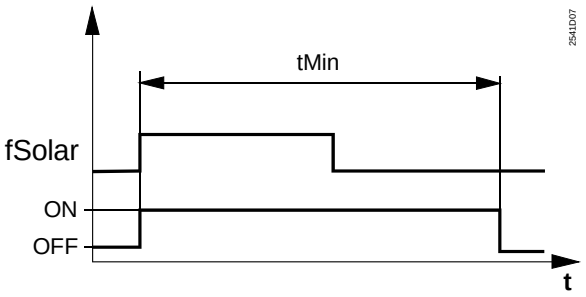


TKol	Collector temperature
ON/OFF	Collector pump
SD_{ON}	Temperature differential ON
SD_{OFF}	Temperature differential OFF
TLmin	Minimum charging temperature
T	Temperature
t	Time

- Charging is stopped (even if the switch-on differential is reached) if the collector temperature is below the charging temperature:
  $TKol < TLmin$
- Charging takes place if the collector temperature exceeds the minimum charging temperature (and if the required switch-on differential is reached) by the switch-on differential ($SD_{ON} – SD_{OFF}$):
  $TKol > TLmin + (SD_{ON} – SD_{OFF})$

26.2.3 Minimum runtime

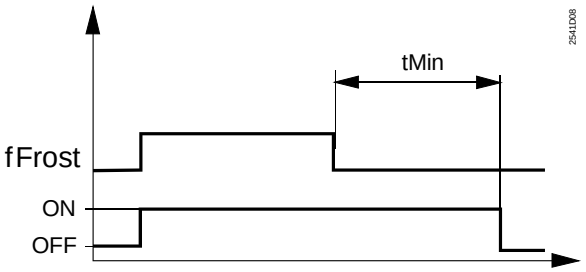
When the collector pump is switched on, it remains on for min. runtime tMin = 20 s. This minimum runtime is enabled for all functions activating the collector pump.



fSolar Solar function
ON/OFF Collector pump
tMin Minimum runtime

Special case: Frost protection

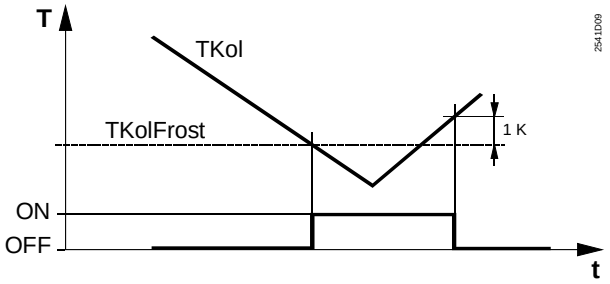
Collector pump switch-off is delayed by the minimum runtime after the frost protection limit is reached to rinse the flow pipe between collector to storage tank with hot water.



fFROST Frost protection function solar
ON/OFF Collector pump
tMin Minimum runtime

26.2.4 Collector frost protection temperature

Operating line 203 is used to set the frost protection temperature for the collector. The collector pump is operated if there is a risk of frost at the collector to prevent the heat carrier from freezing.



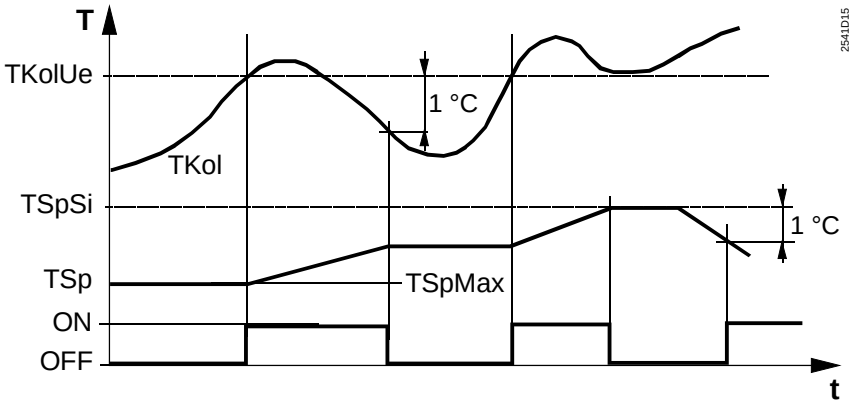
TKol Collector temperature
TKolFrost Collector frost protection temperature
ON/OFF Collector pump
T Temperature
t Time

- The collector pump switches on if the collector temperature drops below the frost protection temperature: TKol < TKolFrost
- The collector pump is switched off if the collector pump rises above the frost protection temperature by 1 K: TKol > TKolFrost + 1K.
- The frost protection function is stopped if d.h.w. storage tank temperature drops below 8 °C.

Setting --- switches off the collector frost protection function.

26.2.5 Collector temperature to protect against overheating

Operating line 204 allows for setting the temperature protecting the collector against overheating.
If there is a risk of overheating at the collector, storage tank charging is continued past the charging temperature maximum limitation (set on operating line 206) to the storage tank temperature maximum (set on operating line 207) to reduce the amount of surplus heat.
Collector overheating protection is no longer possible and the collector pump is switched off after the storage tank temperature maximum limitation is reached.



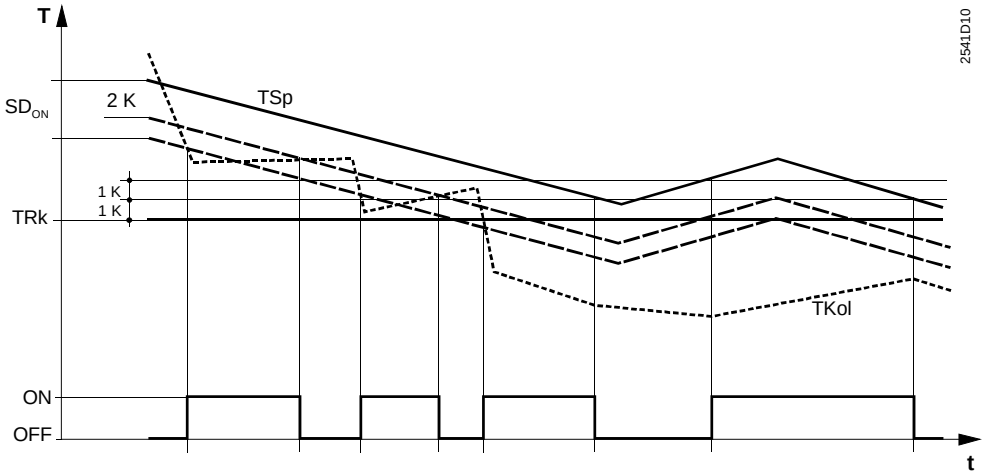
TSpSi	Storage tank temperature maximum limitation
TSp	Storage tank temperature
TKolUe	Collector overheating protection temperature
TSpMax	Charging temperature maximum limitation
TKol	Collector temperature
ON/OFF	Collector pump
T	Temperature
t	Time

- The collector pump is switched on if the collector temperature exceeds the collector temperature overheating protection temperature and if the storage tank temperature maximum limitation is not yet reached: TKol > TKolUe and TSp < TSpSi.
  The collector pump is switched off if the collector temperature drops by 5 K below the overheating protection temperature: TKol < TKolUe – 5 K
- The collector pump is switched off if the current storage tank temperature reaches the maximum limitation:
  TSp > TSpSi
  The collector pump is again switched on if the storage tank temperature drops by 1 K below the d.h.w. storage tank temperature maximum limitation:
  TSp < TSpSi – 1 K

In the case of two storage tank sensors, the hotter of the two is the decisive sensor.
Setting --- switches off collector overheating protection.

26.2.6 Storage tank recooling

Function "Storage tank recooling" cools down d.h.w. storage tank – after collector overheating protection – to a lower temperature level.
Storage tank recooling is carried out via collector surface. In this case, the energy of the d.h.w. storage tank is emitted in the environment via the collector surface by switching on the collector pump.
The recooling setpoint (TRk) is set to a fixed 80 °C.
The switching differential for recooling (SDON) corresponds to the value of the switch-on differential (operating line 201) of charge control, but is limited to min. 3 K for recooling.

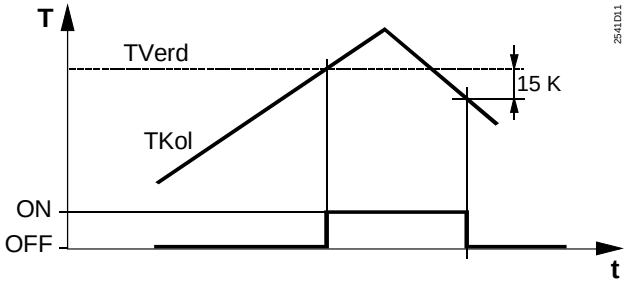


SD$_{ON}$	Temperature differential ON	ON/OFF	Collector pump
TRk	Recooling setpoint	T	Temperature
TSp	Storage tank temperature	t	Time
TKol	Collector temperature		

- The collector pump is switched on if the storage tank temperature is at least 2 K above the recooling setpoint and above the collector temperature by temperature differential ON.
  TSp > TRk + 2 K and TSp > TKol + SD$_{ON}$
- The collector pump is switched off if the collector temperature rises to 2 K of the storage tank temperature.
  TKol > TSp – 2 K
- The function is stopped if the storage tank temperature reaches the recooling setpoint to 1 K.
  TSp < TRk +1 K

26.2.7 Evaporation temperature of heat carrier

Operating line 205 allows for setting the evaporation temperature of the heat carrier. If there is a risk of evaporation at the heat carrier (due to the high collector temperature), the collector pump is switched off to prevent it from running hot. This is a pump protection function.



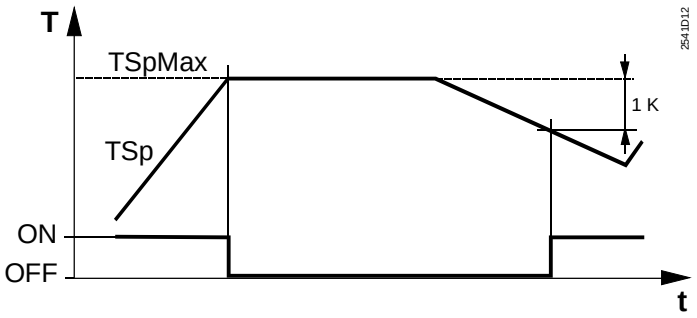
TVerd	Evaporation temperature of heat carrier
TKol	Collector temperature
ON/OFF	Collector pump
T	Temperature
t	Time

- The collector pump is switched off if the collector temperature exceeds the evaporation temperature:
  TKol > TVerd
- The collector pump is again switched on if the collector temperature drops below the evaporation temperature by 15 K:
  TKol < TVerd – 15 K

Setting --- switches off the pump protection function.
The heat carrier evaporation protection (pump off) takes priority over overheating protection which would switch on the pump.

26.2.8 Maximum limitation of charging temperature

Operating line 206 allows for setting the maximum limitation for charging temperature. The collector pump is switched off if the maximum charging temperature in the storage tank is reached.



TSp	Storage tank temperature
TSpMax	Maximum limitation of the charging temperature-
ON/OFF	Collector pump
T	Temperature
t	Time

- Charging is stopped if the storage tank temperature exceeds the maximum limitation:
  TSp > TSpMax
- Charging is again released if the storage tank temperature drops below the maximum limitation by 1 K:
  TSp < TSpMax – 1 K

Note

The collector overheating protection function can again activate the collector pump until the storage tank temperature maximum limitation is reached.

26.2.9 Storage tank temperature maximum limitation

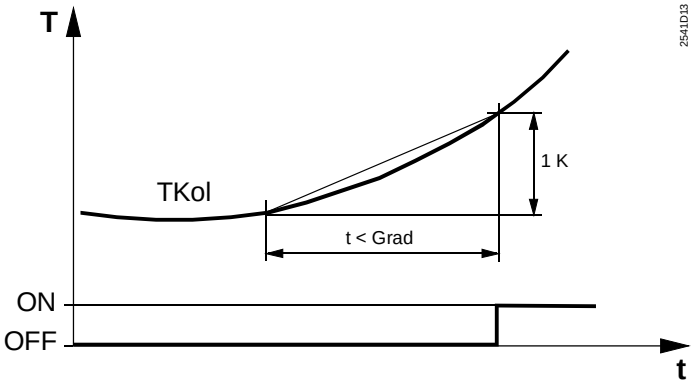
Operating line 207 allows for setting the d.h.w. storage tank temperature maximum limitation.
The storage tank is never charged in excess of the set temperature (refer to section "26.2.5 Collector temperature to protect against overheating").

Caution

The storage tank maximum limitation function is not a safety function!

26.2.10 Collector start function gradient

The pump must periodically be switched on, as the temperature at the collector (primarily vacuum pipes) cannot be measured reliably when the pump is off.
Operating line 208 allows for setting the collector start gradient function.
The pump is switched on if the collector temperature increases by less than the set gradient. The pump remains on if the required temperature increase at the collector is reached within one minute.
The pump is again switched off if the collector temperature does not reach the required level or continues to drop.
The gradient corresponds to the time period required to increase the collector's stationary temperature by 1 °C.



TKol	Collector temperature
Grad	Gradient
ON/OFF	Collector pump
T	Temperature
t	Time

Setting --- switches off the collector start function.

27 Function block "Locking functions"

On the software side, all settings can be locked to prevent tampering.
Also, the settings required for district heat applications can be locked on the hardware side.

27.1 Operating line

Line	*Function, parameter*	*Factory setting (range)*	*Unit*
248	Locking of settings	0 (0…2)	

27.2 Locking the settings on the software side

On operating line 248, the settings made on the controller can be locked on the software side. This means that the settings made can still be called up on the controller, but cannot be changed. Locking may comprise:

- All settings
- Only the settings required for the district heat parameters

The settings can be changed via the bus.

The procedure is the following:

1. Press buttons ▽ and △ together until Cod appears in the display.
2. Press buttons ▽, △, − and +, one after the other.
3. Now, operating line 248 appears in the display. The following locking choices are available:
   0 = No locking
   1 = All settings are locked
   2 = Only the settings required for the district heat parameters are locked (operating lines 101 to 117)

After locking all settings, the following setting elements remain operative:

- The buttons for selecting the operating lines
- The Info button

No longer operative will be:

- The buttons for the readjustment of values
- The bar for changing the basic setting of the heating curve
- The knob for readjustment of the room temperature
- The operating mode buttons
- The manual mode button

27.3 Locking the settings for district heat on the hardware side

The settings for district heat (operating lines 101 through 117) can be locked by bridging terminals H3–M. This locking has priority over locking on the software side. If locking is made on the hardware side, settings via the bus can no longer be changed either. To make the link across H3–M inaccessible, the controller can be sealed to prevent its removal.
Refer to chapter “29 Handling".

28 Communication

28.1 Combination with room units

28.1.1 General

- Room units can be used with the RVL481 only if one of the plant types 1–x, 2–x, or 3–x has been selected on the controller
- The room temperature acquired by a room unit is adopted by the RVL481 at terminal A6. If the room temperature signal delivered by the room unit shall not be considered by the control functions, the respective source needs to be selected (operating line 65). The other room unit functions will then be maintained
- The connection of an inadmissible room unit is detected by the RVL481 as a fault and displayed as such on operating line 50 (error code 62)
- Faults that the room unit detects in itself are displayed by the RVL481 on operating line 50 (error code 61)
- The identification number of the room unit can be called up on operating line 196

28.1.2 Combination with room unit QAW50

Room unit QAW50 with room temperature sensor and room temperature readjustment (setting knob)

The QAW50 can act on the RVL481 as follows:
- Overriding the operating mode of the heating circuit
- Readjustment of room temperature

For this purpose, the QAW50 has 3 operating elements:
- Operating mode slider
- Economy button (also called presence button)
- Knob for room temperature readjustments

Overriding the heating circuit's operating mode

From the QAW50, the operating mode of theRVL481 can be overridden. This is accomplished with the operating mode slider and the economy button.
To enable the room unit to act on the RVL481, the following operating conditions must be satisfied:
- AUTO mode for heating circuit
- No holiday period active, no manual operation

The impact of the QAW50's operating mode slider on the RVL481 is as follows:

Operating mode QAW50	*Heating circuit's operating mode RVL481*
AUTO	Auto; temporary overriding with QAW50 economy button possible
	Continuously NORMAL or continuously REDUCED heating, depending on the economy button, permanent overriding
	Protection

Knob for room temperature readjustments

Using the knob of the QAW50, the room temperature setpoint of NORMAL heating can be readjusted by ±3 °C.
The adjustment of the room temperature setpoint on the controller's operating line 1 will not be affected by the QAW50.

28.1.3 Combination with room unit QAW70

Room unit QAW70 with room temperature sensor, time switch, setpoint adjustment and room temperature readjustment (setting knob)

Using the QAW70, the following functions can be performed or the room unit can act on the RVL481 as follows:

- Overriding the heating circuit's operating mode
- Readjustment of room temperature setpoints
- Readjustment of the NORMAL d.h.w temperature setpoint
- Readjustment of room temperature
- Entry of time of day
- Overriding the heating program
- Display of the actual values acquired by the RVL481

For this purpose, the QAW70 has the following operating elements:

- Operating mode buttons
- Economy button (also called presence button)
- Knob for room temperature readjustments
- Buttons for selecting the operating lines
- Buttons for changing the values

Note

The day of the week is calculated automatically by the controller; an adjustment from the room unit QAW70 is not possible.

Overriding the heating circuit's operating mode

From the QAW70, the heating circuit's operating mode of the RVL481 can be overridden. This is accomplished with the operating mode button and the economy button.
To enable the room unit to act on the RVL481, the following operating conditions must be satisfied:

- AUTO mode for heating circuit
- No holiday period active, no manual operation

The impact of the QAW70's operating mode buttons on the RVL481 is as follows:

Operating mode QAW70	*Heating circuit's operating mode RVL481*
AUTO	Auto; temporary overriding with economy button possible
	Continuously NORMAL or continuously REDUCED heating, depending on the economy button, permanent overriding
	Protection

Knob for room temperature readjustments

With the knob of the QAW70, the room temperature setpoint of NORMAL heating can be readjusted by ±3 °C.
The adjustment of the room temperature setpoint on the controller's operating line 1 will not be affected by the QAW70.

Effect of individual QAW70 operating lines on the RVL481

If 1 (slave with no remote operation) is entered on operating line 178 ("Source of time of day") of the RVL481, the time of day on the QAW70 cannot be changed.

Operating line QAW70	*Function, parameter*	*Effect on RVL481, notes*
1	Setpoint of NORMAL heating	Changes operating line 1 on the RVL481
2	Setpoint of REDUCED heating	Changes operating line 2 on the RVL481
3	D.h.w temperature setpoint	Changes operating line 14 on the RVL481 with plant types with d.h.w. heating
4	Weekday (entry of heating program)	Corresponds to operating line 4 on the RVL481
5	1. Third heating period, start of NORMAL heating	Changes operating line 5 on the RVL481
6	1. Third heating period, start of REDUCED heating	Changes operating line 6 on the RVL481
7	2. Third heating period, start of NORMAL heating	Changes operating line 7 on the RVL481
8	2. Third heating period, start of REDUCED heating	Changes operating line 8 on the RVL481
9	3. Third heating period, start of NORMAL heating	Changes operating line 9 on the RVL481
10	3. Third heating period, start of REDUCED heating	Changes operating line 10 on the RVL481
11	Display of weekdays 1…7	Cannot be adjusted (refer to subsection „7.3 Time of day and date“)
12	Entry of time of day	Changes operating line 38 on the RVL481
13	Display of d.h.w. temperature	Only with plant types with d.h.w. heating (corresponds to line 27)
14	Display of boiler temperature	(Only with plant types 2–x)
15	Display of flow temperature	(Only with plant types 1–x and 3–x)
16	Holidays	RVL481 changes to protection mode
17	Reset to default values	QAW70 default values are used
51	Bus address	Bus address to be entered on the room unit is 1
52	Identification of room unit	Display on operating line 196 of the RVL481
53	Operating lock on QAW70	No impact on RVL481
58	Type of setpoint display	No impact on RVL481

Note

For detailed information about the QAW70 room unit, refer to Installation Instructions 1637 (74 319 0173 0).

Overriding the QAW70 entries from the RVL481

If the RVL481 with a connected QAW70 is isolated from the mains network and then reconnected, the following parameters on the QAW70 will be overwritten with the settings made on the RVL481:

- Time of day and weekday
- Complete heating program
- Room temperature setpoint of REDUCED heating
- Room temperature setpoint of REDUCED heating
- NORMAL d.h.w temperature setpoint

This means that the RVL481 is always the data master.

28.2 Combination with SYNERGYR central unit OZW30

Based on the room temperature of the individual apartments, the OZW30 central unit (software version 3.0 or higher) generates a load compensation signal. This signal is passed on via the LPB to the RVL481 where it produces an appropriate change of the flow temperature setpoint.

28.3 Communication with other devices

The RVL481 offers the following communication choices:

- Signaling the heat demand of several RVL481 to the heat source
- Exchange of locking and forced signals
- Exchange of measured values such as outside temperature, return temperature and flow temperature, as well as clock signals
- Controller RVL481 is not compatible with the RVL469; RVL479 is downward compatible
- Exchange of error messages

For detailed information about the communication via LPB, refer to the following pieces of documentation:

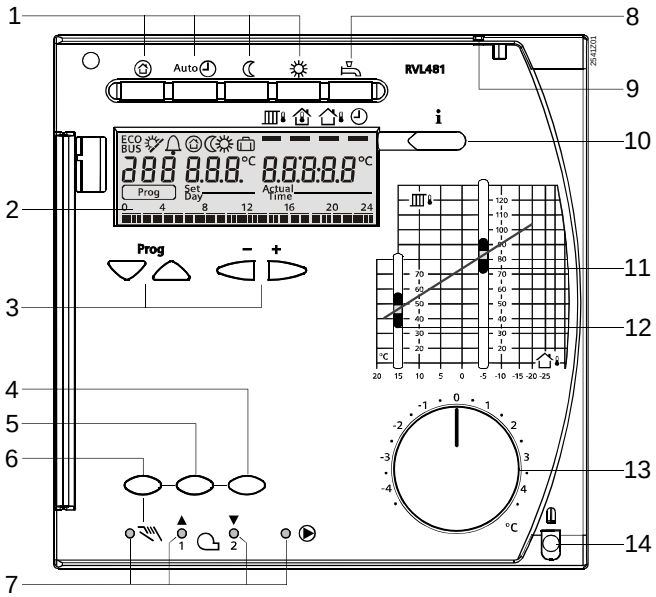
- Data Sheet 2030, "Basic System Data"
- Data Sheet 2032, "Basic Engineering Data"

29 Handling

29.1 Operation

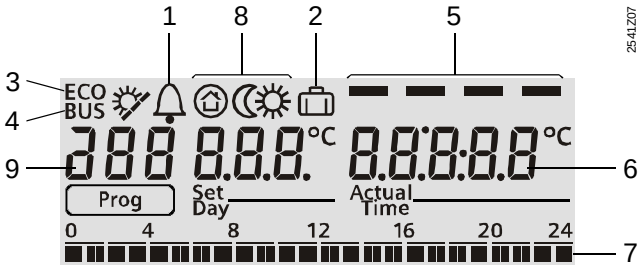
29.1.1 General

Operating elements



1 Operating mode buttons (selected button is lit)
2 Display (LCD)
3 Buttons for operating the display:
Prog = selection of operating line
– + = adjustment of displayed value
4 Button for “Close heating circuit mixing valve” or burner stage 2 ON/OFF in manual operation
5 Button for “Open heating circuit mixing valve” in manual operation
6 Button for manual operation
7 LEDs for:
Manual operation
Heating circuit mixing valve opens / burner stage 1 ON
Heating circuit mixing valve closes / burner stage 2 ON
Pump runs
8 Button for d.h.w. heating ON/OFF (ON = button lit)
9 Sealing facility in the cover
10 Info button for the display of actual values
11 Setting slider for flow temperature setpoint at an outside temperature of –5 °C
12 Setting slider for flow temperature setpoint at an outside temperature of 15 °C
13 Setting knob for readjustment of room temperature
14 Fixing screw with sealing facility

Display



1 Display of error messages
2 Display of "Holiday program active"
3 Display of "ECO function active"
4 Display of "Bus power supply available"
5 Pointer for Info button (display of temperatures)
6 Display of temperatures, times, etc.
7 Display of the current heating program
8 Display of operational level
9 Display of the current operating line number

Operating instructions

The Operating Instructions are inserted in a holder at the rear of the cover. When in their proper place, the list of operating lines that can be selected by the enduser is visible.
The Operating Instructions are designed for use by janitors and endusers. They also contain tips on energy savings and troubleshooting.

29.1.2 Analog operating elements

Buttons for selecting the heating circuit's operating mode

For the selection of the operating mode, there are 4 buttons available. Each button has an LED integrated; the currently active operating mode is indicated by the respective LED.

D.h.w. button

A button is used to switch d.h.w. heating on and off. By pressing the respective button, d.h.w. heating is switched on or off. The button is lit when d.h.w. heating is switched on. Manual d.h.w. charging is also triggered by pressing the same button.

Heating curve

For direct setting of the heating curve, the little bar is used, which has proved its worth over many years. The slider on the left is used to set the required flow temperature at an outside temperature of 15 °C, the slider on the right to set it at –5 °C.
The link between the 2 sliders represents the heating curve.
The heating curve can also be set via operating lines. In that case, the position of the little bar is of no importance.

Knob for room temperature readjustments

A knob is used for, making manual room temperature readjustments. Its scale gives the room temperature change in °C.
By turning the knob, the heating curve is displaced parallel (functionally), but the bar maintains its position.

Buttons and displays for manual operation

3 buttons are used for manual operation:

- One button for the activation of manual operation. An LED indicates manual operation. Manual operation is quit by pressing the same button again or by pressing any at the operating mode buttons
- 2 buttons for manual positioning commands.
  In plants using mixing valves, the regulating unit can be driven to any position by pressing the respective button .
  In plants with direct burner control, burner stage 2 can be switched on and off by pressing button ▼.
  When pressing a button, the associated LED is lit.

Display of positioning commands

The LEDs by the symbols ▲ and ▼ indicate the positioning commands:
/ ▲ = mixing valve in heating circuit fully OPEN or first burner stage ON
/ ▼ = mixing valve in heating circuit fully CLOSED or second burner stage ON

Display "Heating operates"

The LED beside the pump symbol is lit as soon heating circuit pump / circulating pump M1 runs, that is, whenever the heating operates.

29.1.3 Digital operating elements

Operating line principle

The entry and readjustment of all setting parameters, the activation of optional functions and the reading of actual values and statuses are based on the operating line principle. An operating line with an associated number is assigned to each parameter, each actual value and each optional function.
The selection of an operating line and readjustment of the display is always made with a pair of buttons.

Buttons

To select and readjust setting values, the procedure is the following:

Buttons	*Procedure*	*Effect*
Line selection buttons	Press button ▽	Selection of the next lower operating line
	Press button △	Selection of the next higher operating line
Setting buttons	Press button −	Decrease of the displayed value
	Press button +	Increase of the displayed value

The value set will be adopted:

- when selecting the next operating line
- by pressing the Info button
- by pressing any of the operating mode buttons

If the entry of --.- or --:-- is required, button − or + must be pressed until the required display appears. Then, the display maintains --.- or --:--.

Block skip function

The operating lines are grouped as blocks. To reach a specific operating line of a block quickly, the other blocks can be skipped, so that it will not be necessary to select all the other lines one by one. This is accomplished by using two combinations of buttons:

Procedure	*Effect*
Keep ▽ depressed and press +	Selection of the next higher function block
Keep ▽ depressed and press −	Selection of the next lower function block

Info button

The Info button is used to obtain basic information about the plant. Pressing this button, the cursor ▬ in the display is placed below the required symbol. The numbers on the display have the following meaning:

Symbol	*Display of*
	Flow or boiler temperature
	Room temperature
	Outside temperature
	Time of day

It is always the information selected last that is continuously displayed.

29.1.4 Setting levels and access rights

Setting levels

The operating lines are assigned to three different levels. Assignment and access are as follows:

Level	*Operating lines*	*Access*
End-user	1 to 50	Press △ or ▽ together
Heating engineer	51 to 197	Press ▽ and △ for three seconds
Locking level	248	▽ Press △ and together until [od appears; then, press ▽, △, − and + one after the other

Access rights

- The enduser can access all analog operating elements. This means that he can select the operating mode, set the heating curve, readjust the room temperature with the setting knob, and activate manual operation.
  Also, he can access operating lines 1 to 50
- The heating engineer can access all operating elements and all operating lines

29.2 Commissioning

29.2.1 Installation instructions

The RVL481 is supplied with Installation Instructions which give a detailed description of installation, wiring and commissioning with functional checks and settings. They have been written for trained specialists. Each operating line has an empty field in which the selected value can be entered.

The Installation Instructions should not be thrown away after use but kept together with the plant documentation.

29.2.2 Operating lines

Operating line "Plant type"

The most important work to be performed when commissioning the plant is entering the required type of plant. This entry activates all functions and settings required for the respective plant type. Operating lines

Other operating lines

All operating lines contain field-proven and practice-oriented values. Coding, guide values, explanations, etc., are given in the Installation Instructions where required.

Operating lines for functional checks

Function block "25 Function" "Service functions and general settings" contains 4 operating lines that are especially suited for making functional checks:

- Operating line 161 permits simulation of the outside temperature
- On operating line 162, each of the output relays can be energized
- On operating line 163, all actual sensor values can be called up
- On operating line 164, the states of the H–x contacts can be called up

If the display shows 🔔, the fault can be pinpointed via the error code on operating line 50.

29.3 Installation

29.3.1 Mounting location

The ideal location for the controller is a dry room, such as the boiler room. Its degree of protection is IP42 to EN 60529, which means that the controller is protected against dripping water.

The permissible ambient temperature is 0…50 °C.

The RVL481 can be fitted as follows:

- In a control panel (on the inner wall or on a top hat rail)
- On a panel front
- In the control panel front
- In the sloping front of a control desk

29.3.2 Mounting choices

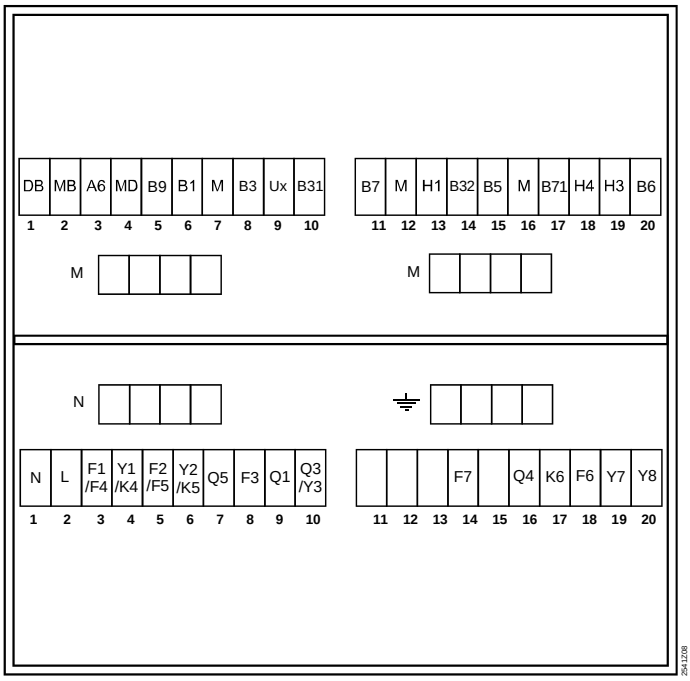
- The RVL481 can be mounted in one of 3 different ways:
- Wall mounting: The base is secured to a flat wall with 3 screws
- Rail mounting: The base is snapped on a top hat rail
- Flush panel mounting: The base is fitted in a panel cut-out measuring 138 × 138 mm. The thickness of the front panel may be 3 mm maximum

29.3.3 Electrical installation

- Local regulations for electrical installations must be complied with
- Only qualified staff may carry out electrical installations
- The cable lengths should be chosen such that there is sufficient space to open the control panel door
- Cable tension relief must be ensured
- The cables of the measuring circuits carry extra-low voltage
- The cables from the controller to the regulating unit and the pump carry mains voltage
- The cables to the sensors must not be run parallel to mains carrying cable (e.g. power supply for the pump) (protection class II EN 60730)

30 Engineering

30.1 Connection terminals



30.1.1 Low-voltage side

DB	Data LPB
MB	Ground for LPB
A6	PPS (point-to-point interface), connection of room unit
MD	Ground for PPS
B9	Outside sensor
B1	Flow or boiler sensor
M	Ground for sensors, changeover contacts and signal output (e times)
B3	D.h.w. flow sensor
Ux	Heat demand output
B31	Storage tank sensor / thermostat 1
B7	Return sensor (primary circuit)
H1	Changeover contact "Operating mode"
B32	Storage tank sensor / thermostat 2
B5	Room sensor
B71	Return sensor (secondary circuit)
H4	Minimum stroke limitation (Y_{min} contact)
H3	Contact for locking the district heat parameters
B6	Collector sensor

In addition to the standard connection terminals, there is an auxiliary terminal M available.

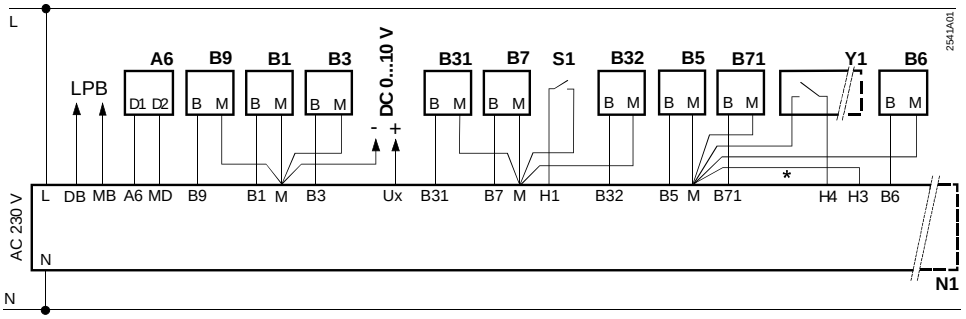
30.1.2 Mains voltage side

N	Neutral conductor AC 230 V
L	Live conductor AC 230 V
F1/F4	Input for Y1/K4
Y1/K4	Heating circuit mixing valve OPEN / first burner stage
F2/F5	Input for Y2/K5
Y2/K5	Heating circuit mixing valve CLOSED / second burner stage
Q5	Collector pump
F3	Input for Q5, Q1and Q3/Y3
Q1	Heating circuit pump / circulating pump
Q3/Y3	Charging pump or changeover valve
F7	Input for Q4 and K6
Q4	Circulating pump
K6	Multifunctional relay
F6	Input for Y7 and Y8
Y7	D.h.w. mixing valve / valve OPEN
Y8	D.h.w. mixing valve / valve CLOSED

In addition to the standard connection terminals, there are 2 auxiliary terminals for N and ⏚ available.

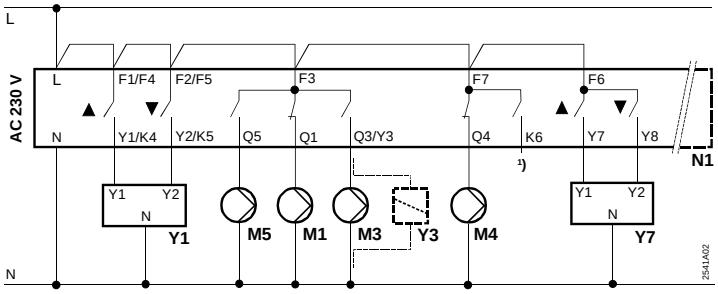
30.2 Connection diagrams

Low-voltage side

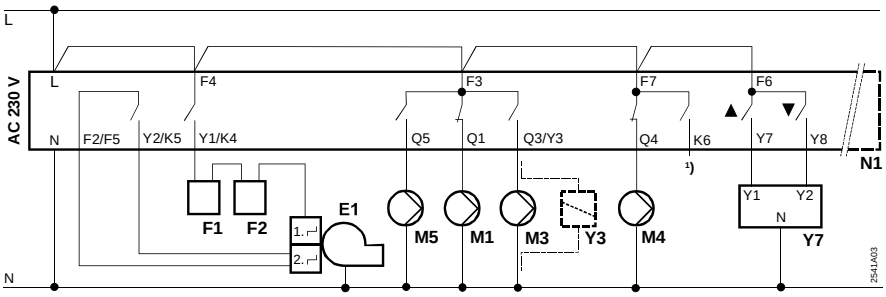


Mains voltage side

Basic connections for plant types with 3-position control (mixing valve)



Basic connections for plant types with 2-position control (boiler with a 2-stage burner)



A6 Room unit
B1 Flow / boiler sensor
B3 D.h.w. flow sensor
B31 Storage tank sensor / thermostat 1
B32 Storage tank sensor / thermostat 2
B5 Room sensor
B6 Collector sensor
B7 Return sensor (primary circuit)
B71 Return sensor (secondary circuit)
B9 Outside sensor
E1 2-stage burner
F1 Thermal reset limit thermostat
F2 Safety limit thermostat
LPB Data bus
M1 Heating circuit pump / circulating pump
M3 Charging pump
M4 Circulating pump
M5 Collector pump
N1 Controller RVL481
S1 Remote operation "Operating mode"
Ux Heat demand output
Y1 Actuator for heating circuit, with contact for minimum stroke limitation
Y3 Actuator of changeover valve
Y7 Actuator for d.h.w. circuit
* Wire link for locking the district heat parameters
[1]) Multifunctional output

31 Mechanical design

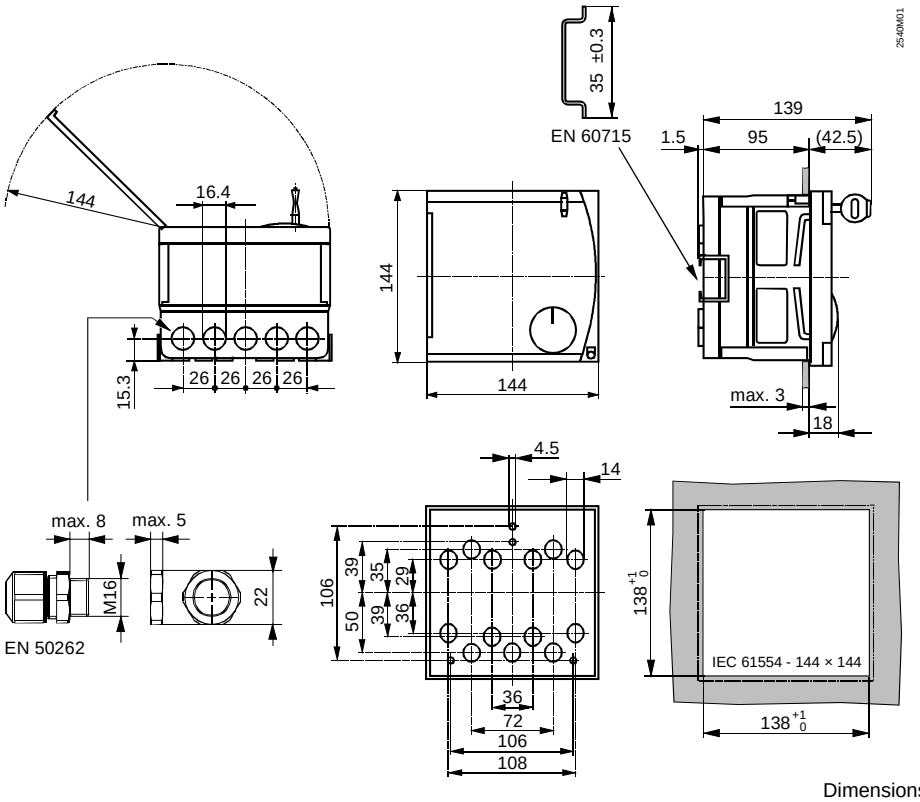
31.1 Basic design

The controller is comprised of controller insert, which accommodates the electronics, the power section, the output relays and – on the front – all operating elements, and the base, which carries the connection terminals. The operating elements are located behind a lockable transparent cover. On the inner side of the cover, there is a holder in which the operating instructions can be inserted.
All values are read in the display (LCD) featuring background lighting.
The cover can be sealed; cover and housing are provided with lugs for introduction of a safety wire.
The RVL481 has standard overall dimensions of 144 × 144 mm.
It can be mounted in one of 3 different ways:

- Wall mounting
- Rail mounting
- Flush-panel mounting

Whichever mounting method is chosen, the base must always be mounted and wired first. To ensure the orientation will be correct, the upper side of both the base and the controller housing carry the marking TOP. Both the top and the bottom side of the base have 5 knockout holes for cable entries, and there are 10 knock-out holes in the floor.
The controller insert is placed in the base. The controller insert has two fixing screws with rotating levels. If, after insertion of the controller insert, one of the screws is tightened, the lever engages in an opening in the base. When the screws are further tightened (alternately), the controller pulls itself into the base so that it is secured.
The fixing screw at the bottom can be sealed: Insert the grommet (attached to the key ring) in the screw hole, introduce a safety wire through the 2 lugs and seal.

31.2 Dimensions



Dimensions in mm

32 Technical data

Power supply	Rated operating voltage	AC 230 V (±10 %)
	Frequency	50 Hz
	Power consumption (no external load)	max. 9 VA
	Supply line fusing	10 A
Output relays	Switching capacity	AC 24…230 V
	Switching current Y1/K4, Y2/K5, Q1, Y7, Y8	AC 0.02…2 (2) A
	Switching current Q5, Q3/Y3, Q4, K6	AC 0.02…1 (1) A
	Rated current of ignition transformer	max. 1 A (max. 30 s)
	Switch-on current of ignition transformer	max. 10 A (max. 10 ms)
Permissible cable lengths to sensors and room unit	Copper cable 0.6 mm ∅	20 m
	Copper cable 0.5 mm^2	50 m
	Copper cable 1.0 mm^2	80 m
	Copper cable 1.5 mm^2	120 m
Connection terminals	Screw terminals for wire section	up to 2.5 mm^2
Communication by wire	Bus protocol/type	LPB
	Bus loading characteristic E	7
Backup	Backup of controller clock	12 h
Standards	CE-conformance to	
	EMC directive	2004/108/EC
	– Immunity	– EN 61000-6-1 / -2
	– Emissions	– EN 61000-6-3 / -4
	Low voltage directive	2006/95/EC
	– Safety	– EN 60730-1 / EN 60730-2-9
Protective data	Safety class	II to EN 60730
	Degree of protection (cover closed)	IP42 to EN 60529
	Degree of contamination	2 to EN 60730
Dimensions		Refer to ”Dimensions“
Weight	Unit (net)	1.2 kg
Colors	Controller insert	Light grey RAL 7035
	Terminal base	Pigeon blue RAL 5014

Environmental conditions	*Operation EN 60721-3-3*	*Transport EN 60721-3-2*	*Storage EN 60721-3-1*
Climatic conditions	class 3K5	class 2K3	class 1K3
Temperature	0…+50 °C	–25…+70 °C	–20…+65 °C
Humidity	<95 % r.h. (non-condensing)	<95 % r.h.	<95 % r.h. (non-condensing)
Mechanical conditions	class 3M2	class 2M2	class 1M2
Use above sea level	max. 3000 m above sea level		

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