Operating Instructions

RC1mx

High Performance Thermostat

METTLER TOLEDO

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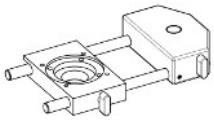
1 Introduction

The RC1mx is a high performance thermostat with the possibility to measure calorimetric data. This product is equipped with the newest hardware and an easy-to-use touchscreen. Together with the iControl software RC1mx is a very powerful calorimeter. The highly reproducible results minimize experimental repetition. Conditions in the RC1mx mimic pilot or manufacturing scale and therefore allow direct assessment of process hazards and the development of safer processes ready for scale up. Decisions made by applying RC1mx data improve the effectiveness of chemical development and ensure that processes are better optimized, more robust, and economically viable.

1.1 Scope of Delivery

Order number		Description	Quantity
30405800 30405799		RC1mx thermostat • Type L • Type H	1
30389896		Touchscreen	1
30398165		Display cable	1
30386516		Cable for stirrer motor	1
30386521		Stirrer motor holder incl. mounting plate	1
30260369		Emergency button	1
51103708		Accessory frame, big	1
51103713		Accessory platform	1
51190436		Oil container (10 L)	1
103026		Spill tray	1

Optional parts

These parts will be shipped according to your order.

Oil kits incl. antistatic additive and suitable O-rings	• MidTemp kit • LowTemp kit • HighTemp kit	• 30399947 • 30399946 • 30400338
Stirrer motors	• Standard torque stirrer • High torque stirrer	• 30395120 • 30374081
Reactors	• Glass reactors • Glass pressure reactors • High pressure reactors • RTCal reactors	

1.2 Check on Arrival

Check the following conditions once the package has arrived:

- The package is in good condition.
- The content shows no signs of damage (e.g. scratches etc.).
- The content is complete (see packaging control list).

If one condition is not fulfilled, please contact your local support.

2 Safety Information

This thermostat has been tested for the intended purposes described in this document. However, this does not absolve you from the responsibility of performing your own tests of the product supplied by us regarding its suitability for the methods and purposes you intend to use it for. You should therefore observe the following safety measures.

We, Mettler-Toledo GmbH, accept no liability whatsoever if you do not observe the following rules and safety notes for safe operation of the thermostat.

2.1 Definition of Signal Warnings and Symbols

Safety notes are indicated by signal words and warning symbols and contain warnings and information about safety issues. Ignoring safety notes can lead to personal injury, damage to the instrument, malfunctions and erroneous results.

Signal words

WARNING	A hazardous situation with medium risk, possibly resulting in death or severe injury if not avoided.
CAUTION	A hazardous situation with low risk, resulting in minor or moderate injury if not avoided.
NOTICE	A hazardous situation with low risk, resulting in damage to the instrument, other material damage, malfunctions and erroneous results, or loss of data.
Note	(no symbol) for useful information about the product.

Meaning of safety symbols


Electrical Hazard


Rotating parts


Explosion


Burn / Heat


General Hazard


Notice

2.2 Intended Use

The RC1mx is a high performance thermostat which is used for scale-up of production and with the HFCal feature to analyse process safety. Be aware that the responsibility for testing your chemicals and reactions lies with you.

Always operate and use your device in accordance with the instructions contained in this manual; use it only together with equipment specified in this documentation.

Any other type of use and operation beyond the limits of these technical specifications without the written consent from Mettler-Toledo GmbH is considered as not intended.

2.3 Product-Specific Safety

Operational safety

For every instrument configuration used, you are responsible for ensuring that the entire system is safe if a power failure occurs and that the reaction in progress cannot get out of control. This especially applies to preprogramed and unattended experiments.

⚠ WARNING

Unqualified staff

Non intended or wrong use of the RC1mx is able to cause hazardous situations or runaway reactions. These events can lead to death or serious injuries.

– Please make sure that only qualified staff operate this device in accordance to general laboratory safety standards.

⚠ WARNING

Risk of electric shock

– Make sure to plug the power cable supplied into a power supply outlet that is grounded. A technical fault could otherwise result in serious injury or death.

⚠ WARNING

Failure of power or cooling

Implement appropriate measures against possibly fatal consequences of a power failure.

– Install a flow monitor with line-independent power supply and continuous monitoring of the coolant flow.

⚠ WARNING

Electrostatic discharges through stirring the reaction mass

The following conditions can form electrostatic charge:

- High flow rates (high stirrer speed) of nonpolar liquids with a high resistivity (>10^8 Ohmmeter).
- Two-phase systems with suspended solids (e.g. after crystallization processes in nonconductive solvents or immiscible liquids.)

– Work under an inert gas (nitrogen or argon).

⚠ WARNING

Risk of explosion due to electrostatic discharges

An explosion could be caused by electrostatic discharges from the flow of the heat transfer oil or stirring the reactor mass. To avoid electrostatic charges of the heat transfer oil do the following:

1 Add the antistatic additive delivered with the product.

2 Purge the oil tank with small amounts of dry nitrogen if you regularly work with an oil temperature (Tj) below room temperature or higher than 180 °C.

➡ This prevents the ingress of atmospheric moisture which destroys the active compound in the antistatic additive.

⚠ WARNING

Hazardous operating situations

Hazardous operating situations could cause an explosion.

To prevent this trigger an emergency cooling, this is done by:

– Pressing the emergency button on the RC1mx.

➡ This cools the reactor to the lowest possible temperature and all operations controlled by a controller instrument will be stopped according to the safety linkage.

⚠ WARNING

Risk of explosion with critical reactions

Performing critical reactions could lead to explosions.

– Perform a safety analysis before starting an experiment with high hazardous potential for example by using a Differential Scanning Calorimeter.

⚠ WARNING

Risk of burns due to removal of protective shield

Do not remove the protective shield before the oil in the reactor jacket has reached room temperature.

⚠ WARNING

Risk of burns when opening the oil drain stopcock

Opening the oil drain stopcock could lead to serious burns if the oil has not reached room temperature.

– Do not open the oil drain stopcock before the oil reaches room temperature.

⚠ WARNING

Wrong oil type selected

– Select the oil type corresponding to that actually used in the RC1mx!

➡ Other oil types could lead to a malfunction of the safety system.

⚠ CAUTION

Rotating parts of stirrer

Rotating parts of a running stirrer may lead to injuries.

1 Do not touch rotating parts of a stirrer.

2 Do not wear loose clothing and make sure jewellery and long hair do not get entangled in the stirrer.

NOTICE

Thermal shock

Glass parts of the instrument or the reactor could get damaged.

– Do not pour cold liquids into hot glassware and vice versa.

NOTICE

Damage to device due to ice particles

If you work regularly with oil temperature below 0 °C ice particles can block the thermostat and lead to a malfunction.

– Purge the oil tank regularly with small amounts of dry nitrogen.

➡ This prevents the ingress and condensation of atmospheric moisture.

NOTICE

Manipulation of reactor inserts while stirrer is running

Inserts or stirrer could get damaged.

– Always turn off the stirrer when manipulating inserts.

NOTICE

Wrong coolant used

High chloride concentration or some additives in the coolant can lead to corrosion of the thermostat.

1 Do not use solutions of NaCl, $CaCl_2$ or DW-Therm.

2 Check compatibility with the wetted parts of the coolant system.

NOTICE

Cooling with cryostats

The cold fluid remaining in the cooling coil would slowly heat up after the RC1mx has been switched off and hence expand. It is possible that the pressure produced by this fluid expansion leads to cracks in the soldering points of the heat exchanger.

– Do not close the input and output of the RC1mx heat exchanger by valves or stopcocks if you use a cryostat to cool the RC1mx.

NOTICE

Service

Comply with the installation requirements concerning location, electrical and water connections.

Contact the METTLER TOLEDO Service if you wish to install or relocate the RC1mx.

Have repair work carried out only by METTLER TOLEDO service. Any unqualified attempt to repair the instrument can endanger the safety system.

NOTICE

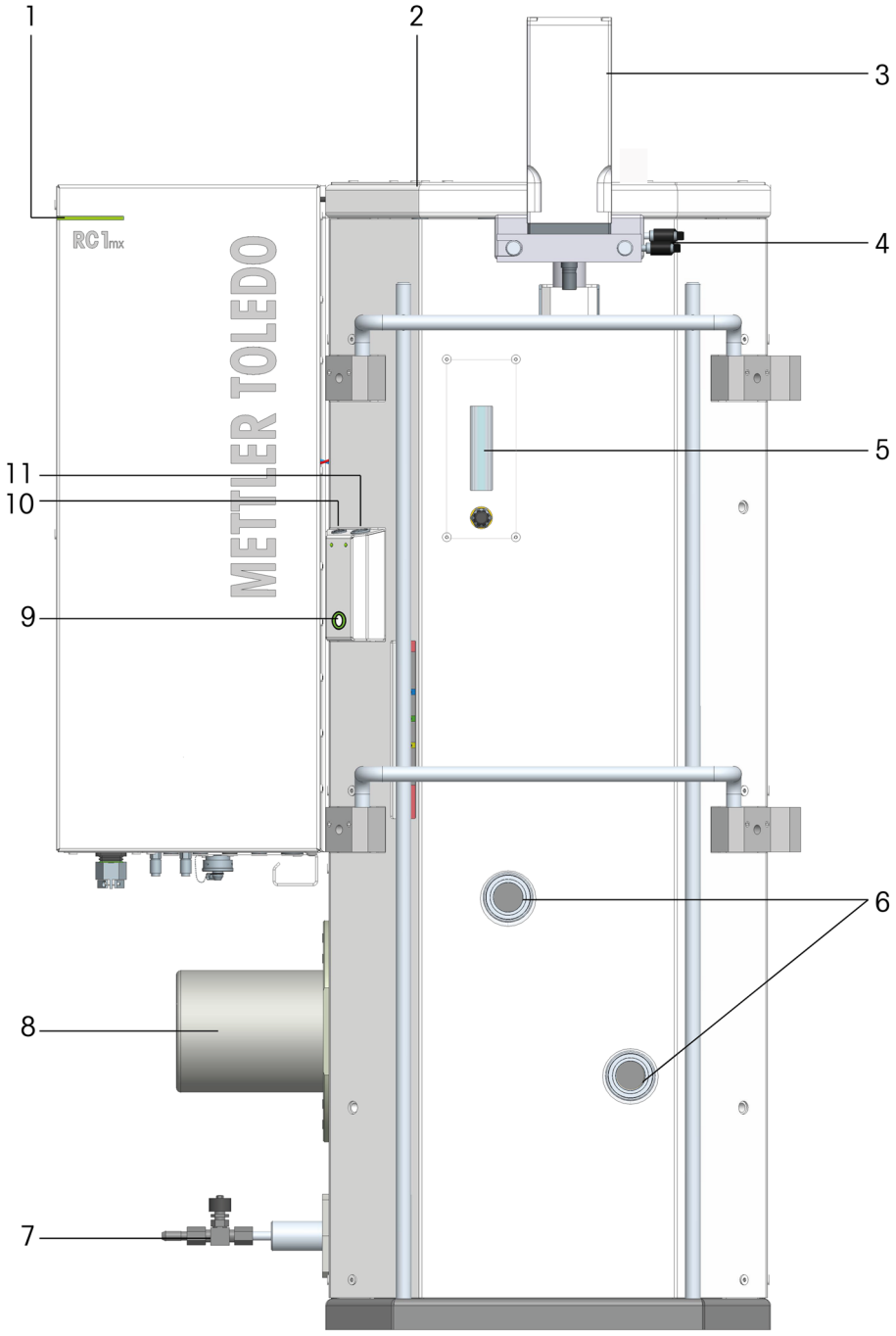
System impedance

This device is intended for connection to a power supply system with a maximum admissible system impedance Zmax of 0.031 Ω at the interface point of the user's power supply.

3 Design and Function

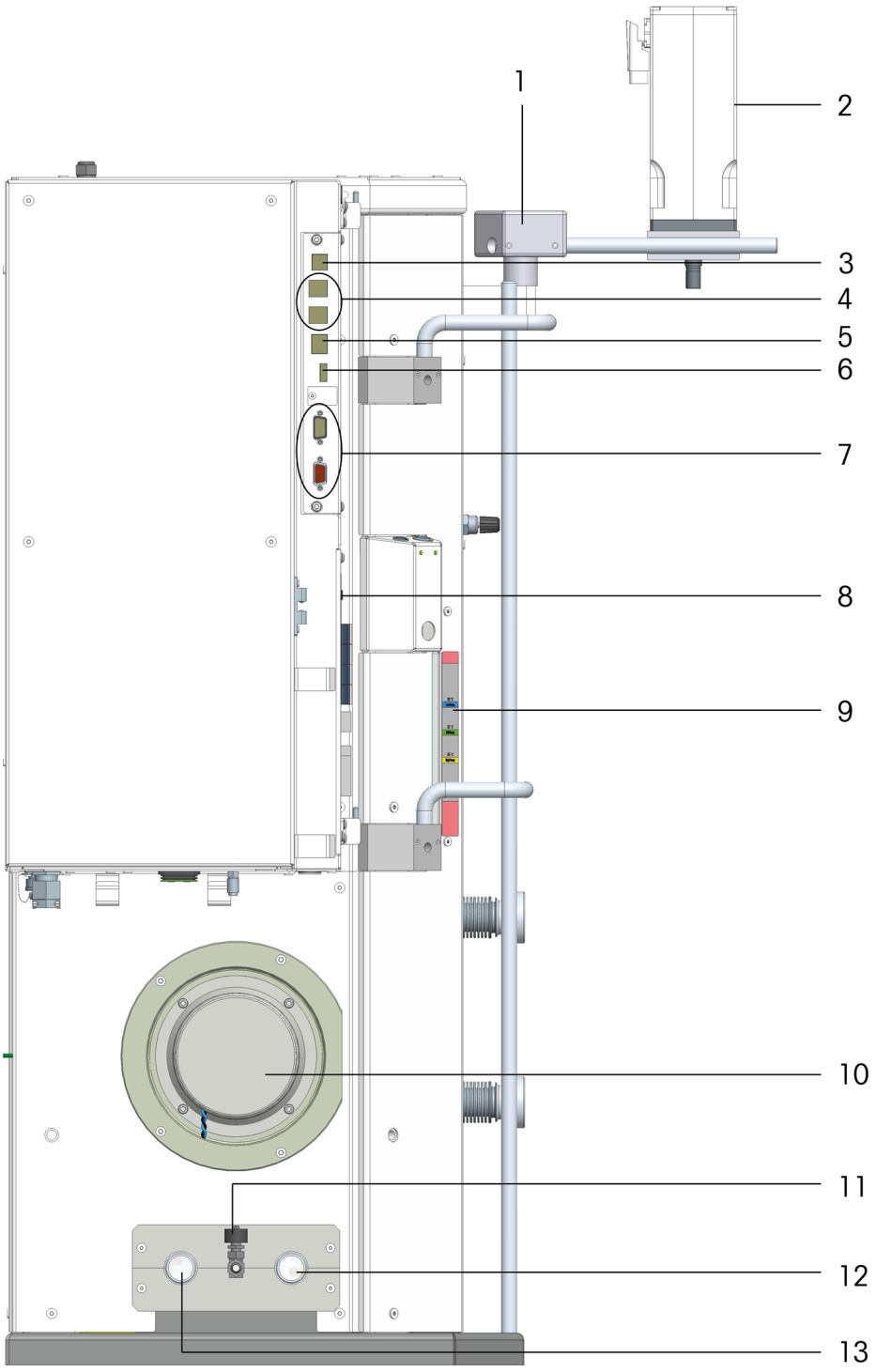
3.1 Overview

Front side



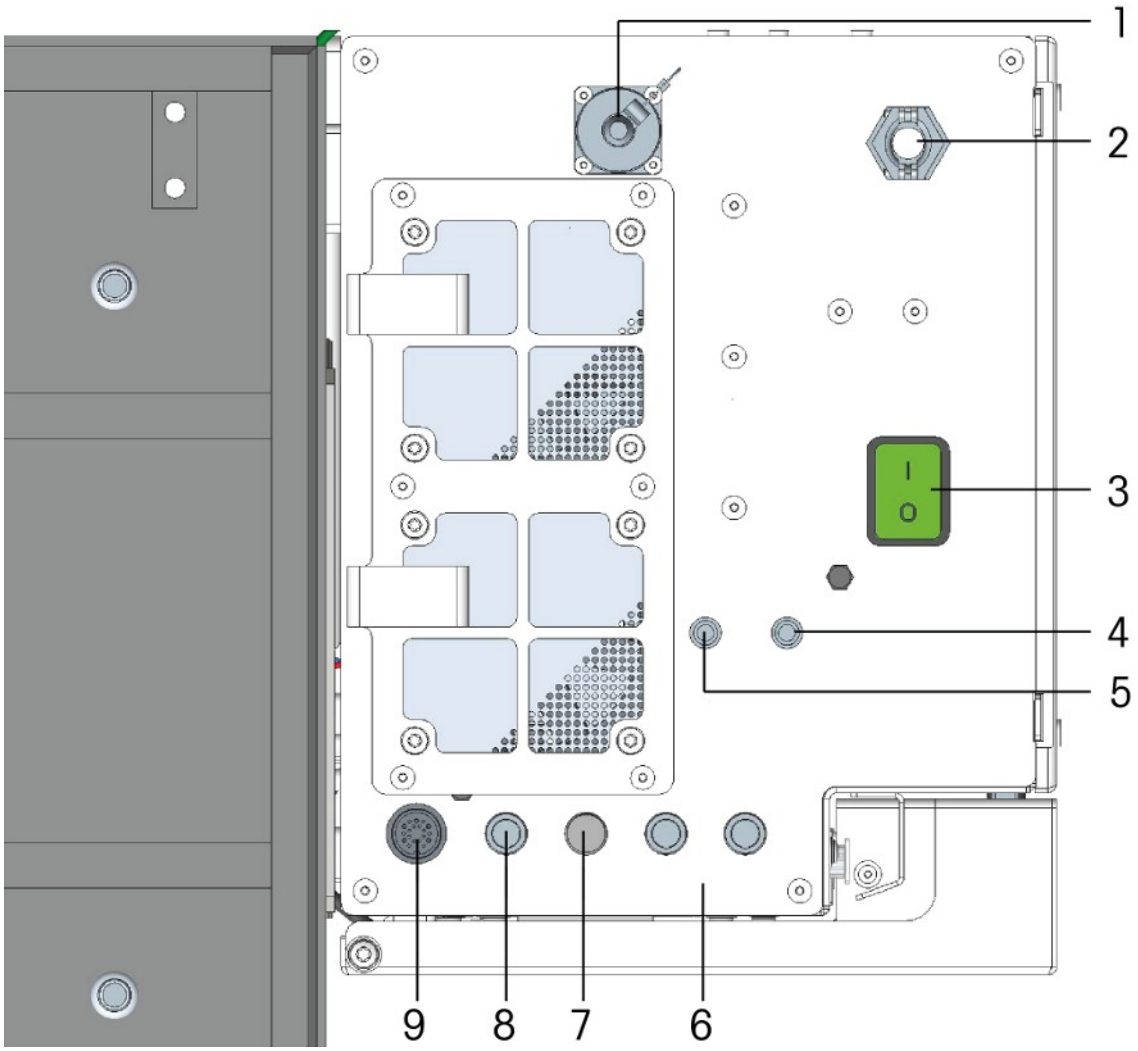
1	Statuslight	2	Stirrer motor socket
3	Stirrer motor	4	Positioning screws
5	Purge gas rotameter	6	Oil connections to reactor
7	Oil drain stopcock	8	Cover for control valve
9	Stirrer on/off button	10	Tr sensor socket
11	Calibration heater socket		

Left side



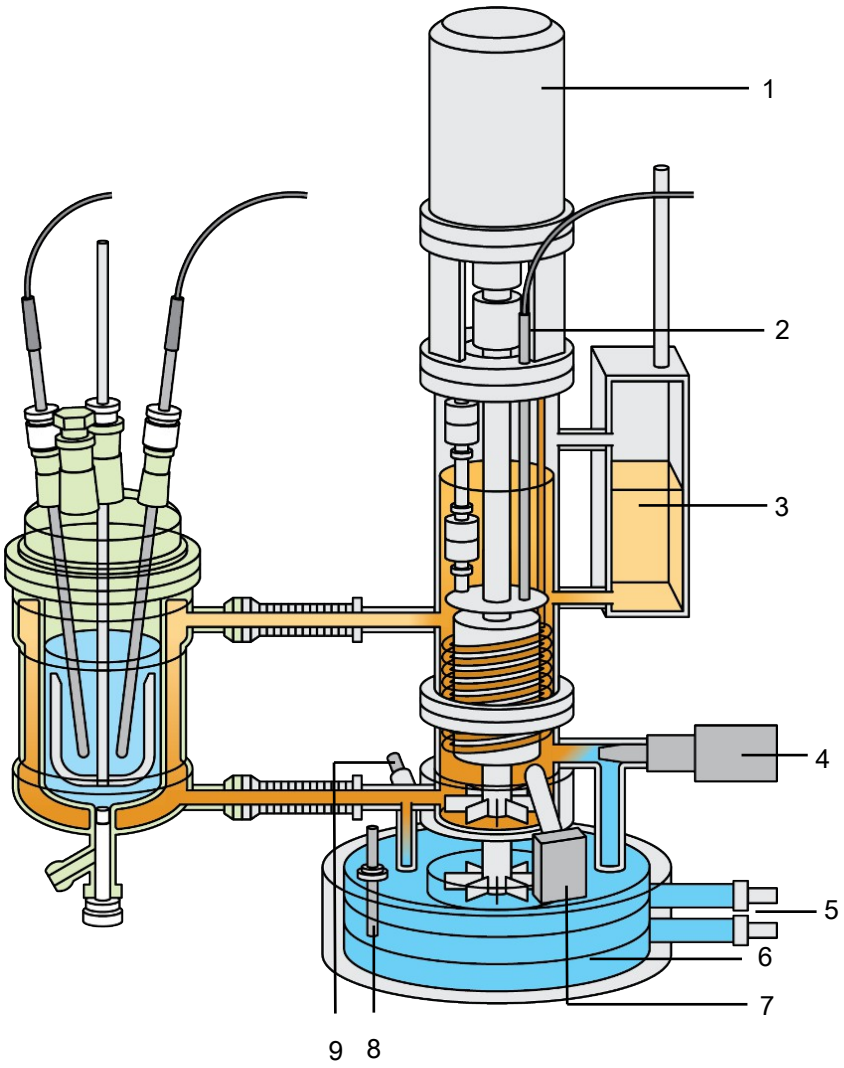
1	Motor support	2	Stirrer motor
3	CAN-1 Out socket	4	USB (4x) sockets
5	Ethernet socket	6	Control unit socket (Touchscreen)
7	RS-232 sockets (2x)	8	Oil type switch
9	Oil level window	10	Cover for control valve
11	Oil drain stopcock	12	Coolant out
13	Coolant in		

Bottom of electronics cabinet



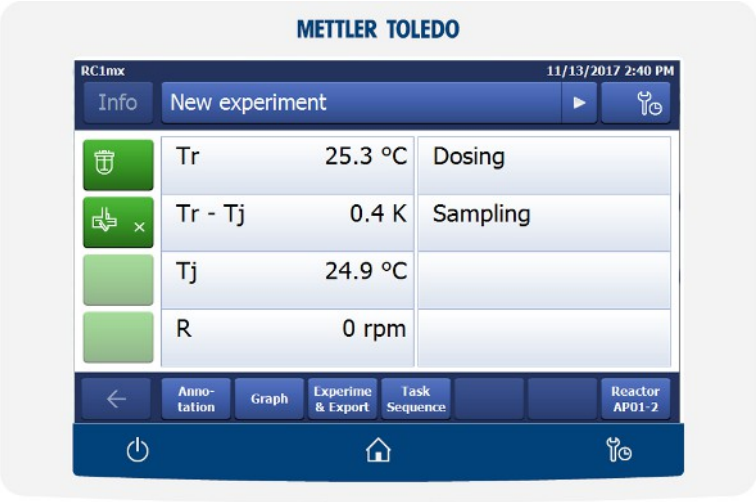
1	CAN-2 Out socket	2	Power cable socket
3	Power button (ON/OFF)	4	Purge-1 Oil socket
5	Purge-2 Electronic Cabinet socket	6	Output DC 24V (2x) socket
7	Safety Relay socket	8	Emergency Button socket
9	RTCal socket		

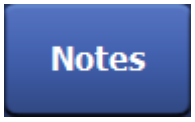
Internal design



1	Pump motor	2	Tjs sensor
3	Expansion tank	4	Control valve
5	Coolant connections	6	Cooling oil container
7	Safety valve	8	Tc sensor
9	Tj sensor		

3.2 Touchscreen Overview



Button	Function
	Reactor overview: Brings you back to main screen from all subtopics.
	Switches the stirrer on () and off (x).
	Sets a time marker in the experiment.
	Allows you to enter an annotation.
	Brings you to the trend graph area.
	Allows you to export experiments or experiments within a defined time frame
	Allows you to create up to six steps of a recipe
	Enters the reactor selection and the safety settings for this experiment.
	Only active if the system has detected an error or warning. Giving more information about what happened.

	Button: Enters the device management topic with possibility to change to system settings. Hardkey on terminal: Enters the system settings directly
	Brings the system into standby mode.
	Brings you back to the main screen.

3.3 Safety System

3.3.1 Intrinsic safety

Safe operation is assured by continuously checking all the functions of the system.

For every instrument configuration, you are responsible for ensuring that the entire system is safe in case of a power-failure. Ensure that any reaction in progress can not run away.

Measures to ensure intrinsic safety

Mechanical

- Separation of the oil circulation systems into a heated and a cooled circulation system; a relatively large cooling capacity is thus available.
- Safety valve for rapid lowering of the oil temperature (bypass of the two oil circulation systems).
- Float switches (oil level detectors).

Electronics

- Monitoring the microprocessor for breakdown (watchdog).
- Monitoring of oil level and Tjs temperature sensor.
- Duplicated arrangement of the temperature sensor: Tj with Tjs (safety sensor).

Software

- Self-test of the microprocessor system after switching on.
- Monitoring of circulation pump and stirrer motor.
- Restriction of the temperature difference "Tj - Tr" to maximum 50 K in the Tr and distillation / reflux mode to avoid glass breakage (maximum 30 K for pressure reactors).
- Monitoring all measured values for plausibility and failure.
- Error recognition and triggering of emergency programs.

3.3.2 Chemical safety

The safety with chemical reactions is assured by monitoring the limit values of the temperatures, the stirrer speed and the measured values of the sensors.

You should define the limit values for each new application after careful consideration of all criteria.

Measures to ensure chemical safety

- Limitation of the Tj set value to Tj end in the distillation or reflux mode.
- Monitoring the limit values for Tr, Tj and Rmax defined by you; triggering emergency programs if limit values are exceeded.
- The safety temperature Tsafe you have defined is used as set temperature for emergency program B or C.
- Monitoring of the plausibility of your entries (prevention of typing errors that could have serious consequences).
- Implementation of additional measures with the safety relay, e.g. an external alarm system with visual and/or audio signals or the activation of additional safety functions such as electromagnetic valves. (You have to implement the measures.)

3.4 Emergency Programs of RC1mx

The microprocessor of the RC1mx can trigger 3 emergency programs; emergency program A can also be triggered by the emergency button.

Emergency program	Action triggered
A	The reaction mass is cooled to the lowest possible temperature as fast as possible (emergency cooling).
B	The reaction mass is cooled under Tj mode control to the value of Tsafe that was last defined.
C	The reaction mass is cooled or heated under Tj or Tr mode control to the value of Tsafe that was last defined

Detailed actions of the emergency programs

Action	Emergency program		
	A	B	C
Message to PC / Touchscreen	x	x	x
Calibration heater off	x	x	x
Stirrer speed to Rsafe or hold actual rpm set	x	x	x
Task sequence is aborted	x	x	x
Pause Dosings	x	x	x
Stop pH control	x	x	x
Heater off	x		
Open safety valve[1]	x		
Fully open control valve	x		
Safety relay: Switch to emergency position (only if safety relay is armed)	x		
Switch over to Tj mode		x	
Tj ramp to Tsafe with gradient -0.1 K/s		x[2]	
If in Distillation / Reflux mode switch over to Tr mode			x
Tj or Tr ramp to Tsafe with gradient ±0.1 K/s			x[3]
If system state is READY (temperature controller in state OFF) then switch to Tj mode and ramp to Tsafe with gradient ±0.1 K/s			x

[1)] Opening the safety valve is tantamount to cooling with the maximum possible gradient; the volume of oil in the cooled circulation system is greater than that in the heated circulation system. The temperature in the double jacket of the reactor is thus lowered rapidly.

[2)] If the current Tj temperature is lower than or equals Tsafe, then Tj is maintained.

[3)] If Tj or Tr lies below Tsafe, heating is applied until Tsafe has been reached.

3.4.1 Error causes of RC1mx

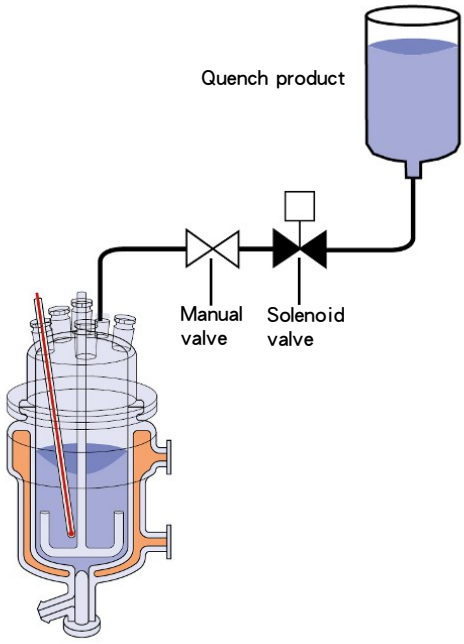
Error cause	Emergency program triggered
Stirrer	
Stirrer overload - Stirrer speed outside limits for (> 30 sec and < 2 min).	Warning
Stirrer overload - Stirrer speed outside limits / torque at max. for > 2 min	B
Stirrer has error (e.g. overheating)	B
Stirrer disconnected (or electronics defective) for < 30 seconds	Warning
Stirrer disconnected (or electronics defective) for > 30 seconds	B
Oil loop	
Oil level too high	B
Oil level too low	A
Oil level sensor 1 / sensor 2 defective Error reading oil level switches	A
Oil circulation pump faulty	A
Oil type switch was manipulated	Warning
Oil type switch is in invalid position	Error
Stepper motor	
Stepper motor communication error	A
Stepper motor - no answer	A
Requested stepper motor position not reached due to positioning error > 400 steps	A
Reference switch unexpectedly triggered	A
Stepper motor controller is in error state	A
Timeout of 6 seconds elapsed while waiting for stepper to successfully initialize.	A
Reference switch was not triggered within timeout of 16 seconds during reference switch search	A
Stepper motor over temperature	A
Stepper motor over temperature warning	Warning
Stepper motor firmware version too old	Error
Power line, power supply	
Mains Voltage (for heater) below lower limit	Warning
Power supply error detected	A
No mains voltage (for heater)	B
Touchscreen firmware	
Touchscreen firmware crashes / Watchdog error	C
Mainboard firmware crashes	A
Powerboard firmware crashes	A
Temperature acquisition	
Tr sensor disconnected while enabled	A
Tr higher than Tr max	A
Tr lower than Tr min	C
Tj lower than Tj min	C
Tj higher than Tj max	A
Tjs higher than (Tjoil max + 14 K)	C
Tj or Tjs sensor defective (sensor reading changes by > 10 K / s)	A
(Tj - Tjs) higher than 14 K	Warning
(Tj - Tjs) higher than 14 K for 1 min	A
abs(Tr – Tj) > (TDiffMax + 3 K)	Warning

Tc sensor defective	A
Tc higher than (Tj + 5 K)	Warning
Tc higher than (Tj + 5 K) for 1 min	A
Tc higher than Tc max	Warning
Tc higher than Tc max for 3 min	A
Tc lower than Tc min	C
Tr, Tj, Tjs, Tc has an error	A

3.5 Quenching a Reaction

Stopping the exothermic reaction by addition of a quench product.

- By addition of a catalyst poison in the case of catalyzed reactions (e.g. acid-catalyzed reaction → add a base, base-catalyzed reaction → add an acid, etc.).
- By addition of a substance that destroys the reagent in a non-exothermic or weakly exothermic reaction (e.g. saponify the reagent with water or alkali).



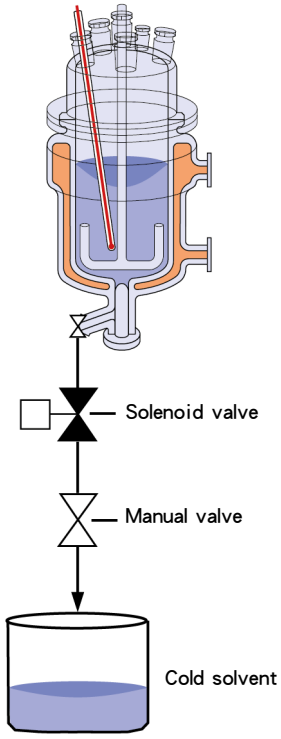
1 The vessel containing the quench product must be placed above the reactor so that the product runs into the reactor when the valve is opened.
2 The solenoid valve must be open on power failure, i.e. it must be open with zero current.
3 To initiate the automatic discharge, you can use the safety relay of the RC1mx as a trigger.
4 You should install the manual valve as an additional safety measure.

3.6 Automatic Reactor Discharge

The reactor contents are discharged through the bottom valve. They are allowed:

- to run out into a cold solvent;
  - they are thus diluted and cooled. The dilution slows the reaction rate down and the larger mass results in a relatively small temperature rise (e.g. discharge of a reaction mass of a condensation into a cold solvent or ice water).
- to be discharged into a cold solvent that stops the reaction (reduction in acidity of the charge, e.g. discharge nitration mass into cold water).
- to be discharged onto dry ice.
  - The reaction is stopped or slowed down dramatically by the powerful cooling.

This measure has the disadvantage that with viscous reaction masses outflow is too slow or even impossible.



1 The receiver must be placed below the reactor so that the reactor contents run out of the reactor when the valve is opened.
2 The solenoid valve must be open on power failure, i.e. it must be open with zero current.
3 To initiate the automatic discharge, you can use the safety relay of the RC1mx as a trigger.
4 You should install the manual valve as an additional safety measure.

3.7 Safety Relay

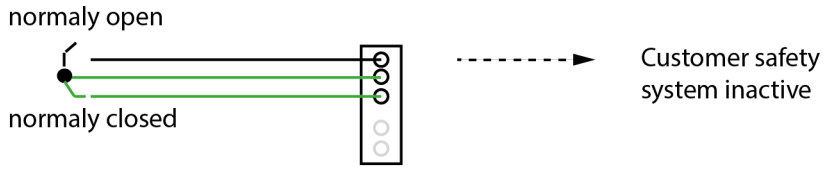
The safety relay connector of the RC1mx has two functions:

- Passive: It acts as connection to the customers security system to initiate safety measures on power failure (discharge of the reactor, quenching of the reaction).
- Active: It can be used as an additional 24 V output.

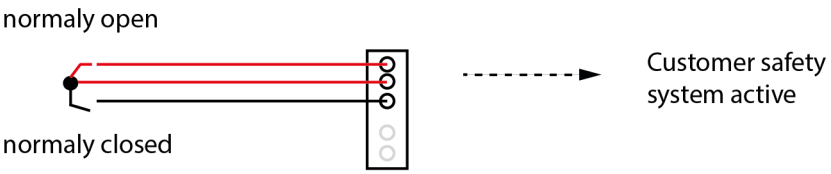
Passive: Safety relay

The following setup applies to this:

No Emergency



Active Emergency program



The safety relay will only react in operation mode ready [Operation Modes Page 20].

In case of an emergency the safety relay will change switch position:

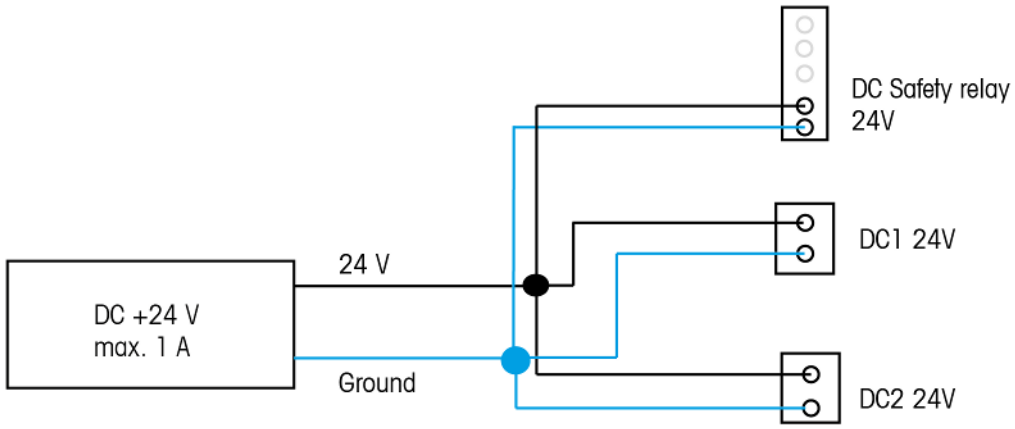
- to close the normally open circuit and therefore activates the customers safety system.
- to open the normally closed circuit is now open.

To avoid unnecessary inflow of the quench product or inadvertent outflow of the charge (e.g. on switching off the RC1mx), you should install an additional manual valve below the solenoid valve and/or a bypass circuit in the electrical connection.

Active: 24 V output

The remaining two pins (always on) of the safety relay can be used as outlet for 24 V. The current is divided between three outputs.

The illustration below shows the connection of the safety relay 24 V output and the other two separate 24 V outputs.



Contact your METTLER TOLEDO service to connect the electromagnetic valves to the safety relay of the RC1mx.

3.8 System Behavior after Power Failure

The system behavior depends on the operation mode the system is in when a power loss occurs. As soon as the power is available again the system will start up again.

The system was in operation mode run when the power failure occurred. It will start up in a safe state performing the following actions:

- Stirring speed is ramped to 100 rpm within 6 seconds.
- Tj will be regulated to the last set Tsafe.

The system was in operation mode ready or standby when the power failure occurred. It will start up in operation mode ready.

3.9 Operation Modes

	Ready	**Run**	**Standby**
Entering mode	At start up of device	Starting a task e.g temperature contro or stirring	Pressing hard-key button Power
Leaving mode	Turn off the device or change to Standby	Abort all running tasks	Taping touchscreen
LED color (Touchscreen / Statuslight)	Green	Green	White
Safety programs	Active	Active	Only hardware emergencies triggered
Safety relay	Disarmed	Armed	Disarmed
Task handling	All tasks can be executed	At least one task is running others can be started	No tasks will be executed Stirring and temperature control tasks get aborted

3.10 Temperature modes

3.10.1 Tr mode

The temperature of the reactor contents is controlled. Thereby Tr is held constant or changed with a ramp. Deviations of the temperature of the reactor contents from the set value (through heat of reaction) are compensated by appropriate correction of the thermostat temperature, i.e. the heat generated is dissipated.

3.10.2 Tj mode

The temperature of the thermostat is controlled. Tj is held at a specific value or changed with a temperature ramp.

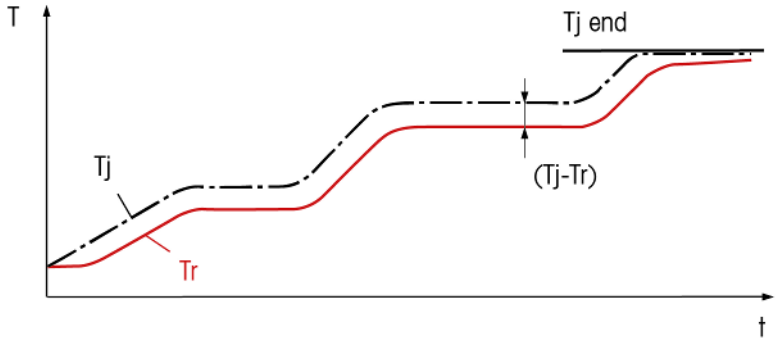
3.10.3 Distill / Reflux mode (Tj-Tr)

Distill / Reflux mode can be used if you want to distill or reflux a solvent or a mixture of solvents, especially when the boiling point(s) are unknown. This mode ensures that when a boiling point is reached, the system will not continue to increase the jacket temperature but will hold the temperature when a certain difference in Tj-Tr is reached.

The value entered for the desired temperature difference between the thermostat and the reactor contents (Tj - Tr) is added to the measured temperature of the reactor contents (Tr) and gives the set value for the control of Tj. For this mode, you have to enter:

- the desired temperature difference, Tj - Tr,
- the upper limit of the jacket temperature, Tj end.

As a result, during the time when the solvent is not boiling, the temperature of the reactor contents, Tr, rises in accordance with the value entered for Tj - Tr. When the reaction mixture is boiling, Tr and hence also Tj remain approximately constant. As soon as Tj end is reached, the final (end) temperature is held.



3.11 Oil Types

There are three oil types with different temperature range:

- LowTemp oil: -70°C to +80 °C
- MidTemp oil: -50 °C (device limit) / -45 °C to +230 °C
- HighTemp oil: -5 °C to +300 °C

The temperature ranges of the oil can be narrower than the device allows. This is due to increased viscosity of the oil at low temperatures, for a sufficient cooling flow we recommend to keep in mind the oil limits.

The RC1mx determines the oil type with the oil type switch on the device. There is no other identification possibility than the switch, it is therefore extremely important to always set it to the correct position. [Exchange Oil Page 58]

On installation of the RC1mx, the heat transfer oil is added together with the antistatic additive to the correct level. The oil level is monitored and will run an emergency when the oil level is too high or low. You should check the oil level at regular intervals. [Check Oil Level Page 57]

3.12 Meaning of LEDs

Statuslight

The Statuslight indicates the status of the instrument as a whole.

Color	Meaning
None	Device switched off
Green	everything OK // Ready to use
Orange blinking	Message for user pending on touchscreen (not urgent)
Red blinking	Error // an unexpected problem happened, user needs to take an action
White	Standby mode

Terminal LED

Color	Meaning
None	Device switched off
Green	Everything ok no error shown on TS
Orange blinking	Warning shown on TS
Red blinking	Error shown on TS
White	Standby mode

Activitylight (Tr sensor / Calibration heater)

There are LEDs below the Tr sensor and Calibration heater which indicate the status of these ports.

Color	Meaning
None	Calibration heater / Tr sensor: Not connected
Green	Tr sensor: connected sensor ready Calibration heater: connected and ready for use. Heater does not heat.
Green blinking	Calibration heater is heating, adjusting or calibrating
Orange blinking	Calibration heater / Tr sensor: initializing /reading cable data
Red blinking	Error, Tr sensor is not OK

ON/ OFF button

There are two On/OFF buttons on the device. One for the device itself and one for the stirrer.

Color	Meaning
None	• Stirrer: not running • Device: no power
Green	• Stirrer: running • Device: power

4 Installation

4.1 Installation Requirements

⚠ CAUTION

Unqualified installation and relocating of the device

An improper installation could lead to a malfunction of the device and serious injuries. The installation of this device should only be done by a trained METTLER TOLEDO Service Engineer. Do not install or relocate the device without the assistance of a METTLER TOLEDO Service Engineer.

⚠ CAUTION

High accessible voltage

– The device must either be permanently connected or use IEC 60309 conform plugs and sockets.

Please consult the RC1mx Pre-Installation Guide to ensure all requirements for a proper installation are fulfilled.

We highly recommend to install an uninterruptible power supply. This can prevent hazardous reactions in case of a power failure.

Location of the device

- Always position the device in a well-ventilated fume hood.
- Always install the device on a surface that is able to carry the weight of the device.
- Install the device in an "autoclave room" when dealing with potentially explosive reactions.

Site requirements

The instrument has been developed for indoor operation in a well-ventilated area. Avoid the following environmental influences:

- Conditions outside of the ambient conditions specified in the technical data
- Powerful vibrations
- Direct sunlight
- Corrosive gas atmosphere
- Explosive atmosphere of gases, steam, fog, dust and flammable dust
- Powerful electric or magnetic fields

4.2 Connecting Power to the Device

⚠ WARNING

Risk of electric shock

– Make sure to plug the power cable supplied into a power supply outlet that is grounded. A technical fault could otherwise result in serious injury or death.

1 Connect the instrument to the mains using the cable attached to the device.

2 Insert the plug of the power cable into a grounded power outlet that is easily accessible.

4.3 Connecting Emergency Button

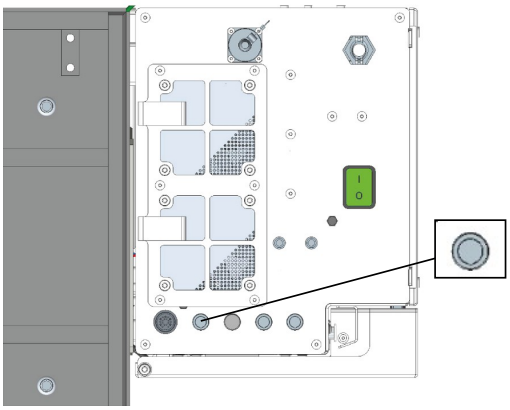
⚠ WARNING

Risk of explosion due to not accessible safeguard button or touchscreen

To be able to prevent a runaway:

– Make sure that the safeguard button and the touchscreen are accessible any time during the experiment.

– Connect the safeguard button to the **Safeguard button** socket on the bottom of the electronics cabinet.



4.4 Connecting Touchscreen to RC1mx

⚠ WARNING

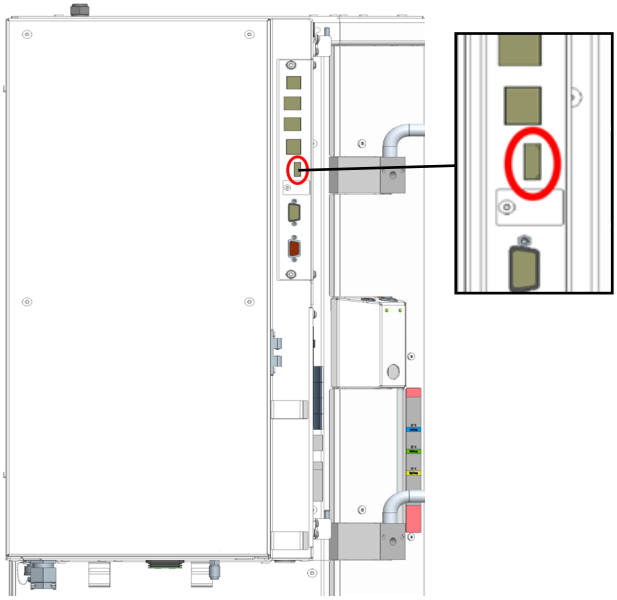
Risk of explosion due to not accessible safeguard button or touchscreen

To be able to prevent a runaway:

– Make sure that the safeguard button and the touchscreen are accessible any time during the experiment.

1 Open the door of electronics cabinet.

2 The touchscreen socket is labelled Control Unit (see picture).



3 Connect the touchscreen cable to the socket.

4.5 Installing a Reactor

Detailed instructions about installing a specific reactor are in the respective Operating Instructions.

⚠ WARNING

Risk of explosion due to damaged reactors

Explosion of a reactor could cause serious injury.

– Check the reactor before each use for damage (scratches, formation of cracks).

4.6 Installing a Stirrer

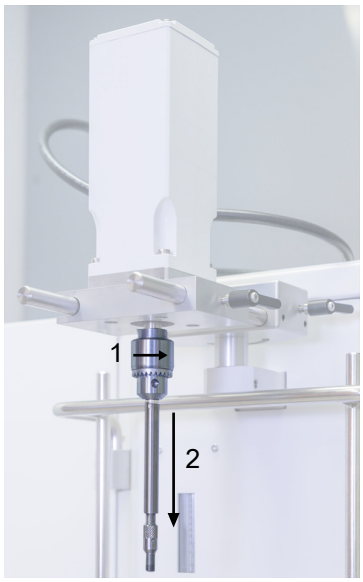
This is an typical instruction for glass reactors, please also consult the respective reactor Operating Instructions for more detailed information.

1 Push the stirrer shaft from below through the opening of the reactor cover.

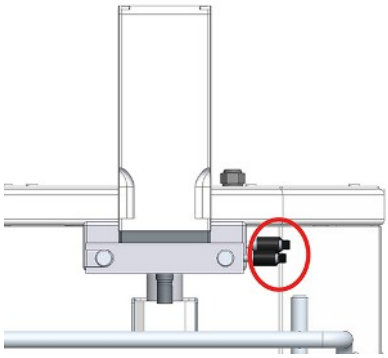
2 Push the stirrer bearing onto the stirrer shaft.

3 Carefully place the cover (with stirrer) on the PTFE ring so that the stirrer does not jam anywhere.

4 Open the chuck (1) using the key and pull the sleeve of the coupling shaft downward (2).



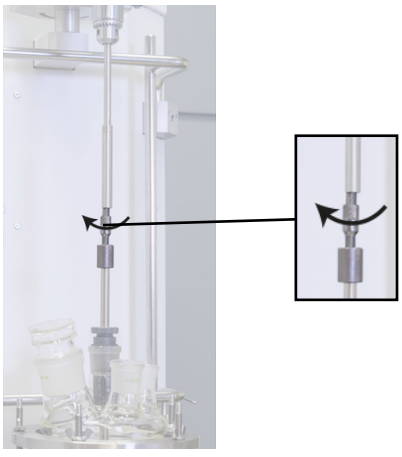
5 Loosen the positioning screws.



6 Align the coupling over the stirrer bearing of the stirrer shaft by moving the stirrer motor slightly to the left and right, or backward and forward.

7 Tighten the positioning screws again.

8 Screw the stirrer shaft and the coupling together.



9 Check that the stirrer rotates properly by turning it manually at the chuck; the flexible shaft must not touch the sleeve.

10 Position the stirrer about 1 cm above the bottom of the reactor and tighten the chuck.

4.7 First Oil Fill

- Make sure you have already mounted the correct reactor.
- Emergency button is released.
- The RC1mx is switched off.

1 Connect the tubing to the oil drain stopcock on the side of instrument.

2 Secure it with a hose clamp.

3 Connect the other end of the tubing to the provided oil container (10 L volume).

4 Secure it with a hose clamp.

5 Fill the first small oil container (approx. 5 L) into the 10 L container.

6 Add one bottle of antistatic additive.

7 Fill the second small oil container (approx. 5 L) into the 10 L container.

8 Place the oil container on a higher level than the oil drain stopcock.

9 Open the oil drain stopcock.

10 Check the oil level window on the front panel of the device and wait until the appropriate level for the oil type is reached.

11 Close the oil drain stopcock.

12 Open the electronics cabinet and put the oil type switch to the correct position.

13 Switch on the RC1mx.

➡ When switching on the RC1mx the touchscreen may show a manipulation warning which you have to acknowledge or decline.

14 Enter a Tj of 25 °C on the touchscreen and allow the oil to circulate for approx. 5 minutes to check whether the oil level changes due to trapped air bubbles.

15 Check the oil level in the oil level window. If it becomes too low, put the device to stand-by mode and fill in more oil until the correct level has been reached. Then re-start the temperature control.

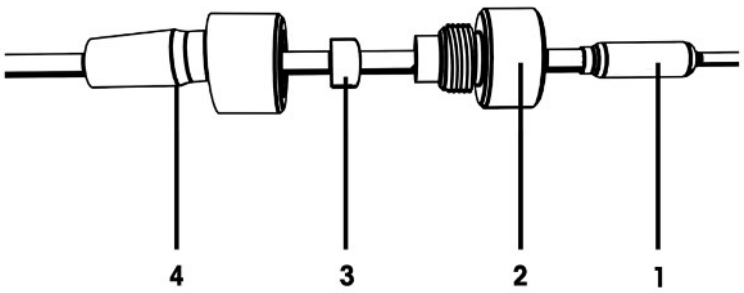
16 Let it run for about 10 minutes to drive off all air bubbles.

4.8 Connecting Tr sensor

NOTICE

Do not disconnect the cables by pulling on the cable

This could damage the connectors. Only pull out the cable at the end using the plug.



1 Unscrew the pressing screw (**2**) from the adapter and push it over the sensor (**1**).

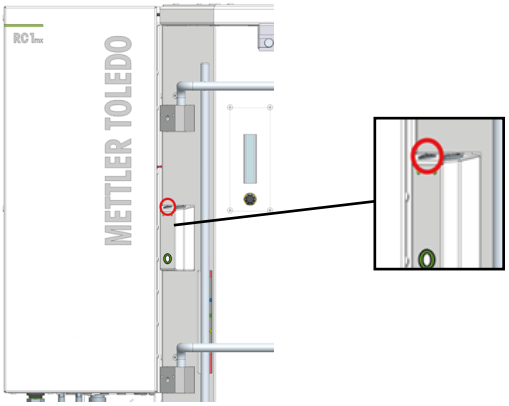
2 Push the sealing ring (**3**) over the Tr sensor with the round side pointing to the screw (**2**).

3 Push the lower part of the adapter (**4**) over the Tr sensor.

4 Screw the adapter (**3** & **2**) lightly together.

5 Install the Tr sensor (**1**) on the reactor cover (in an appropriate port).

6 Connect the Tr sensor to the Tr connection on the instrument.



7 The Tr sensor connection is on the side of the instrument (see red marking).
8 Align the red dot on the plug with the red dot on the socket of the instrument.
9 Check that the Tr sensor is sufficiently immersed into the reaction mass.

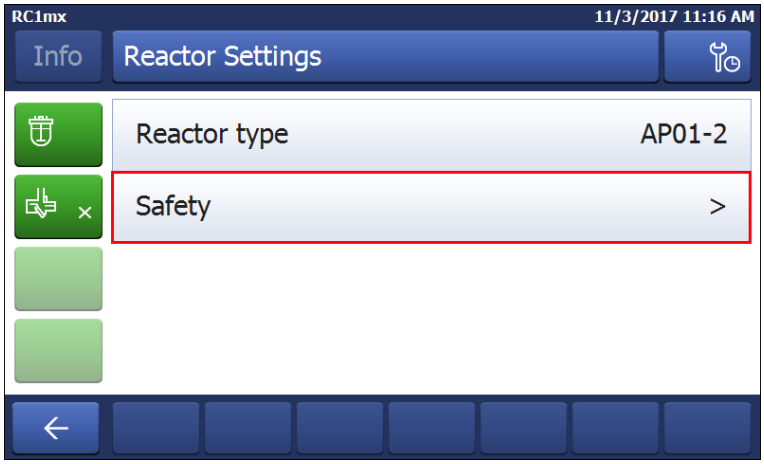
4.9 Turn on Device

- Make sure the device is properly installed and the reactor correctly mounted.
- Press the ON/OFF Button on the bottom of the electronics cabinet.
- The touchscreen should illuminate.
- The Statuslight should turn green.

5 Operation

5.1 Change safety settings

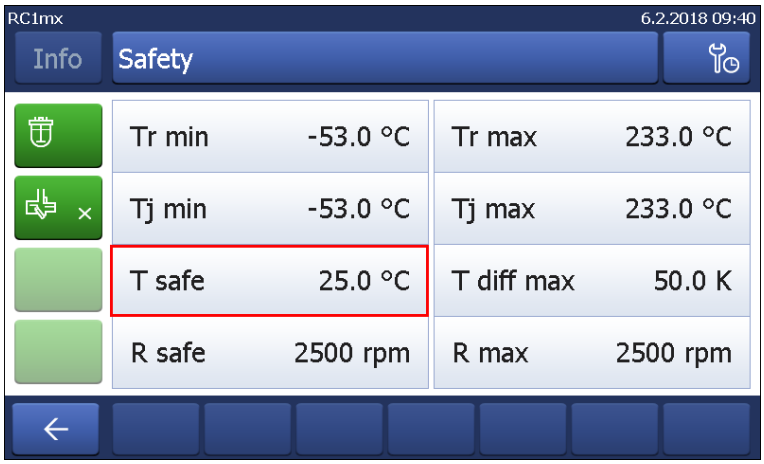
1 Tap the Reactor button.



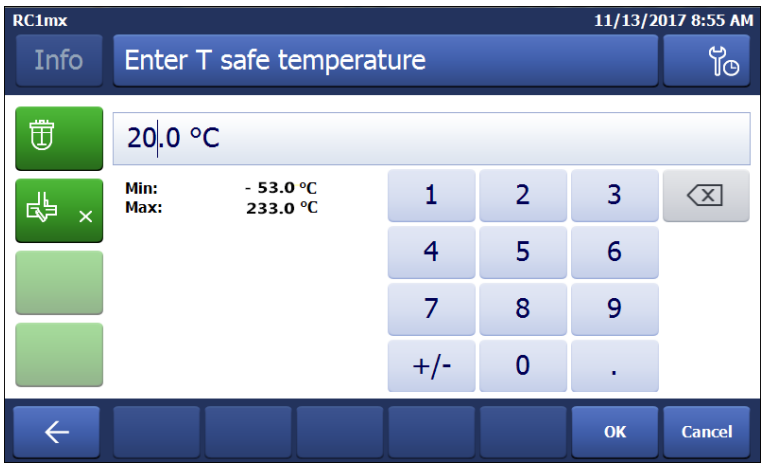
2 Tap on the **Safety** field.

3 Change the necessary parameters according to your experiment and setup.

5.1.1 Change safety temperature (T safe)



1 Tap on **T safe**.

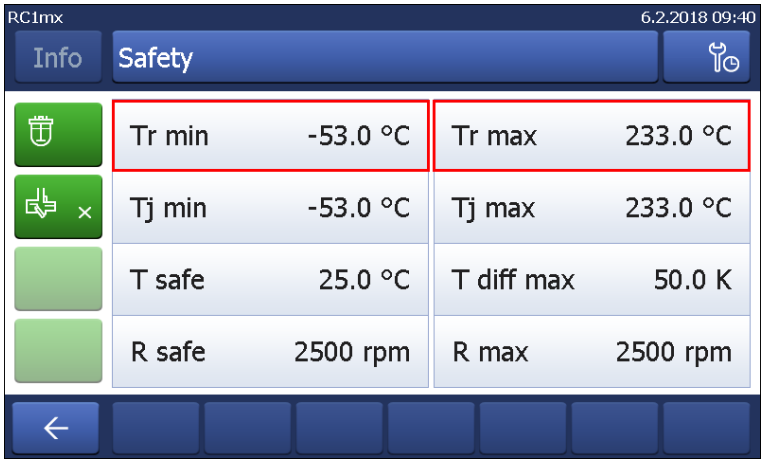


2 Enter a value for **T safe** that is valid for your experiment.

3 Tap **OK**.

Parameter	Description	Values
Tsafe	Defines the temperature to which the reaction will be cooled in case of an emergency program B or C.	According to your chemistry

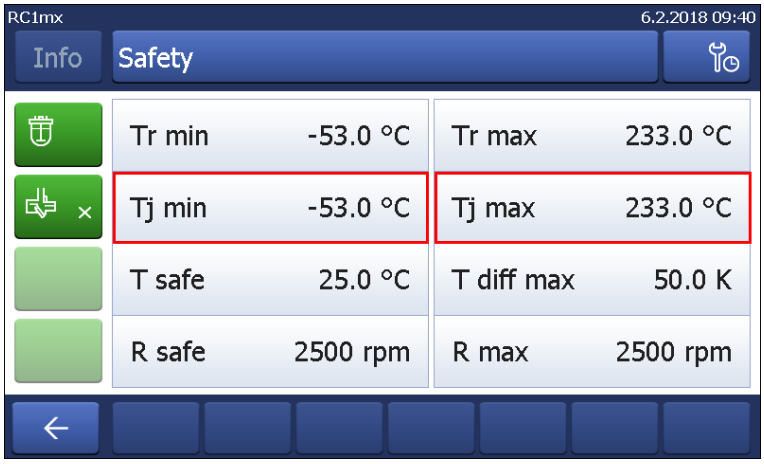
5.1.2 Change reaction temperature limits (Tr)



1 Tap on **Tr max** or / and **Tr min**.
2 Enter a value for **Tr max** and **Tr min** that is valid for your experiment.
3 Tap **OK**.

Parameter	Description	Values
Tr max	Defines the maximum temperature a Tr value can reach during an experiment and the user can enter in the reactor view. If the temperature rises above that value the emergency program A is triggered.	Dependent on: • Oil type • Reactor type
Tr min	Defines the minimum temperature the Tr value can reach during an experiment and the user can enter in the reactor view. If the temperature falls below that value the emergency program C is triggered.	Dependent on: • Oil type • Reactor type

5.1.3 Change range of jacket temperature (Tj)



1 Tap on **Tj min** or / and **Tj max**.
2 Enter a value for **Tj min** and **Tj max** that is valid for your experiment.
3 Tap **OK**.

Parameter	Description	Values
Tj max	Defines the maximum temperature a Tj value can reach during an experiment and the user can enter in the reactor view. If the temperature rises above that value the emergency program A is triggered.	Dependent on: • Oil type • Reactor type
Tj min	Defines the minimum temperature the Tj value can reach during an experiment and the user can enter in the reactor view. If the temperature falls below that value the emergency program C is triggered.	Dependent on: • Oil type • Reactor type

5.1.4 Change T diff max

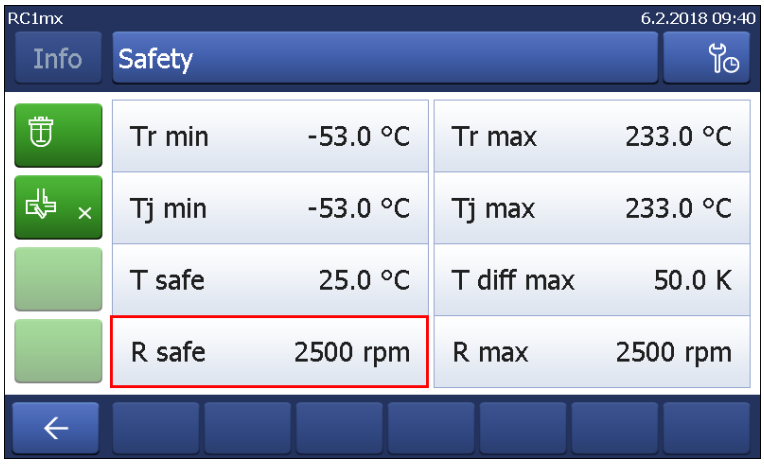
1 Tap on **T diff max**.

2 Enter a value for **T diff max** that is valid for your experiment.

3 Tap **OK**.

Parameter	Description	Values
T diff max	Defines the temperature difference that is allowed between Tj and Tr.	Dependent on: • Reactor type

5.1.5 Change Rsafe



1 Tap on **Rsafe**.
2 Enter a value for **Rsafe** that is valid for your experiment.
3 Tap **OK**.

Parameter	Description	Values
Rsafe	Determines the stirrer speed in case of an emergency.	• Hold rpm • User-defined rpm: 0 -2500 rpm

5.1.6 Change Rmax

1 Tap on **Rmax**.
2 Enter a value for **Rmax** that is valid for your experiments.
3 Tap **OK**.

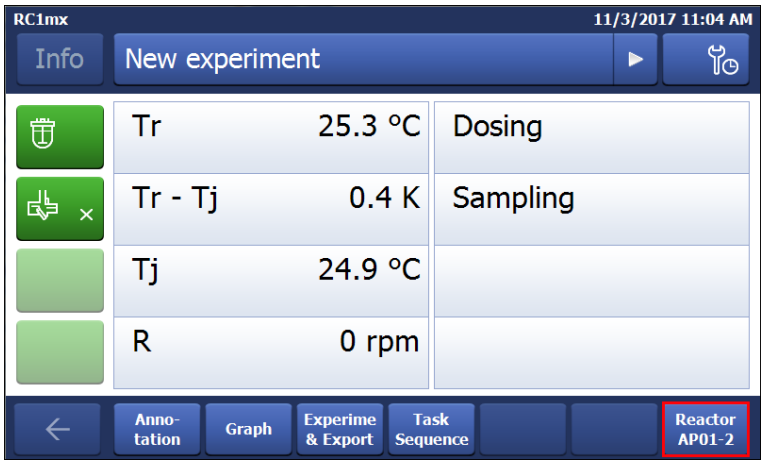
Parameter	Description	Values
Rmax	Defines the maximum stirrer speed the stirrer can reach during an experiment. Should the value of Rmax be exceeded an emergency will be triggered. If the experiment is controlled with iControl all stirrer types already have defined maximum stirrer speeds. It is possible to define a narrower maximum stirrer speed due to experimental conditions.	Depended on: • Stirrer • Reactor type

5.2 Experiment

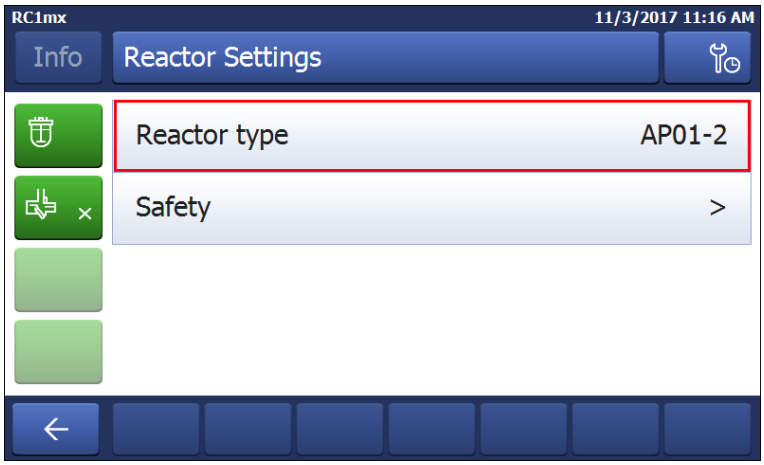
5.2.1 Select Reactor Type

The RTCal reactor is automatically recognized as soon as the reactor is connected to the device. This means no selection of the reactor is required on the touchscreen.

1 Tap the button **Reactor AP01-2**.

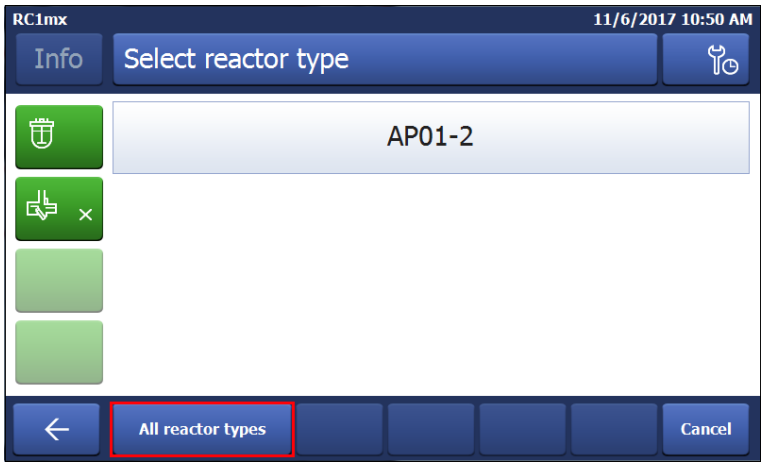


2 Tap the **Reactor type** field.



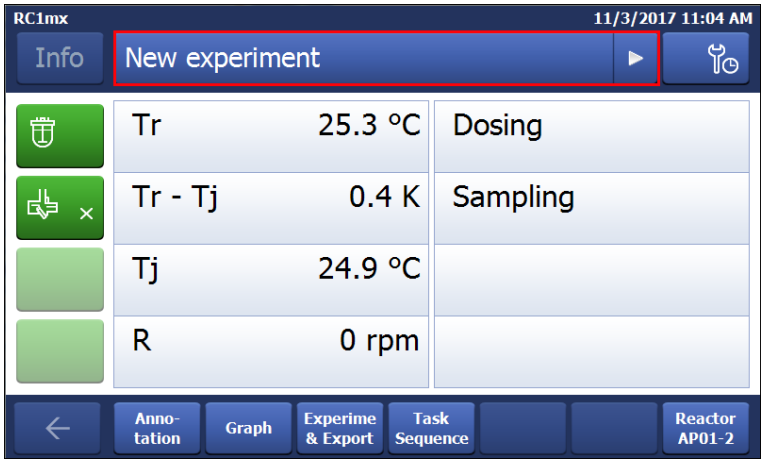
3 Select the reactor type that is installed.

4 More reactor types can be found under **All reactor types**.



5.2.2 Start an experiment

Data that is stored outside of an experiment is lost when turning off the device. Data within the experiment is stored on the device for 10 days.



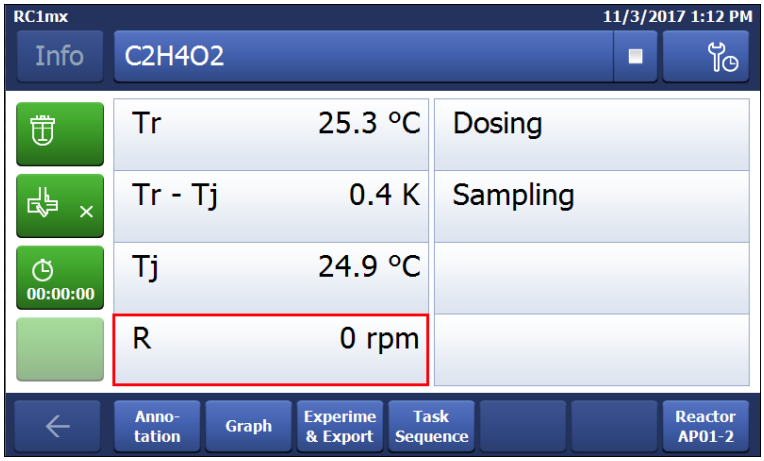
1 Tap the experiment button on the main screen.
2 Enter an **experiment name**.
3 Tap **Start** to start the experiment.
➡ All tasks that are executed will be saved under the experiment and available for export.

5.2.3 Stirring

5.2.3.1 Change stirrer speed

Note The value cannot be higher than the safety limit value.

- A stirrer is connected.



1 Tap on the **R** field.

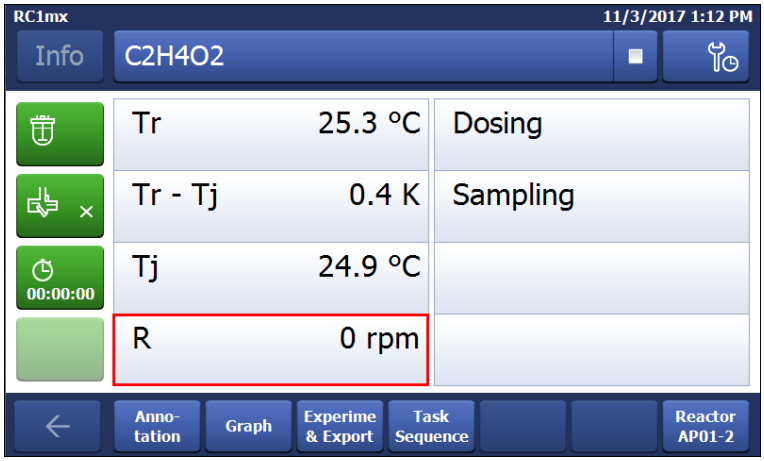
2 Enter the desired value.

3 Tap **Start**.

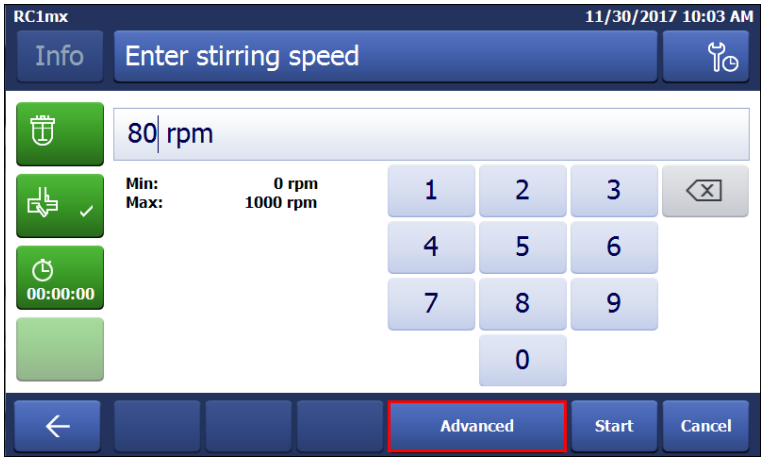
➡ The stirrer will immediately start stirring.

5.2.3.2 Create a stirrer speed ramp

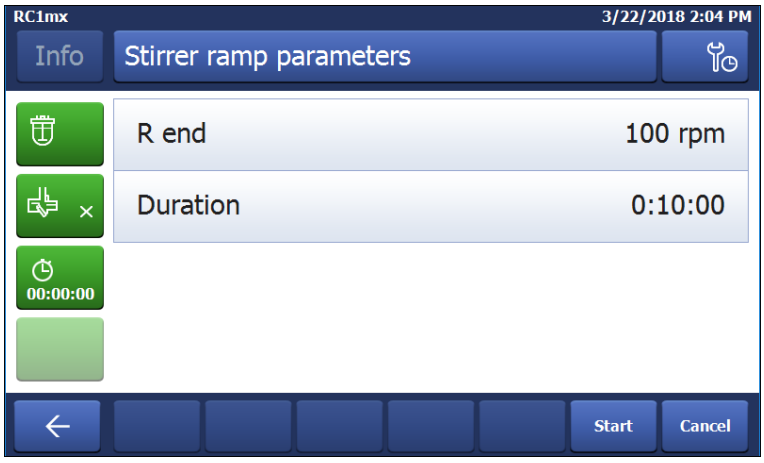
- A stirrer is connected.



1 Tap the **R** field.



2 Tap **Advanced**.



3 Enter a stirrer end speed (R end).

4 Enter the duration of the ramp.

5 Tap **Start**.

➡ The stirrer will immediately start stirring.

5.2.4 Add a time marker

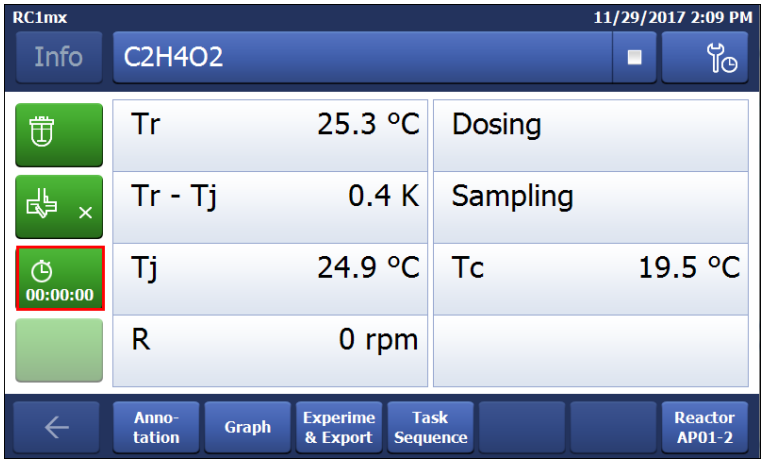
The time marker is only active if an experiment is running.

Time markers can be added on the touchscreen with two possibilities:

- Action button in green on the left side of main screen.
- In the Trend graph viewer by tapping on the trend graph.

Parameters	Description
Time marker	The time marker allows users to define a specific moment within an experiment which he wants to refer to a time "zero" e.g. the addition of a catalyst or the nucleation of the first crystal. Once a first time marker is set, the user has an additional option to shift the timeline, setting time zero on the time marker. A user may choose to set multiple time markers, allowing to shift time zero to different spots throughout the experiment.

Add time marker on main screen



1 Tap on the time marker symbol on the main screen.

2 Enter a name for the time marker.

3 Tap **OK** to add the time marker to the experiment.

Add time marker in the trend graph

1 Tap on the **Graph** button.

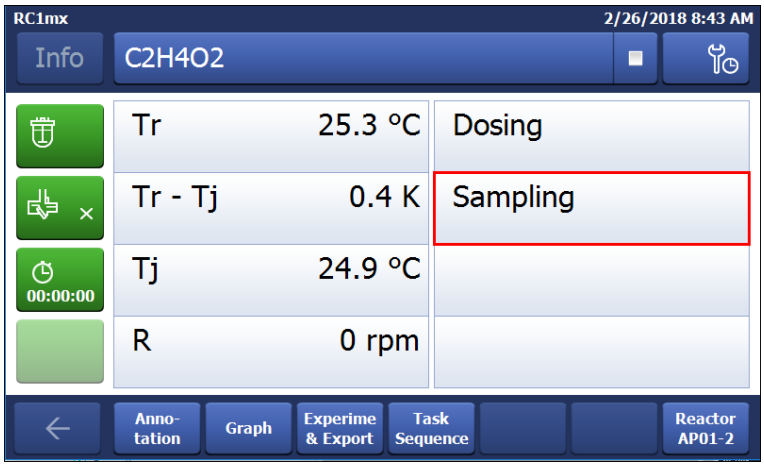
2 Tap in the graph area where you would like to set a time marker.

3 Choose time marker from the options.

4 Enter a name for the time marker.

5 Tap **OK** to add the time marker to the experiment.

5.2.5 Manual sampling

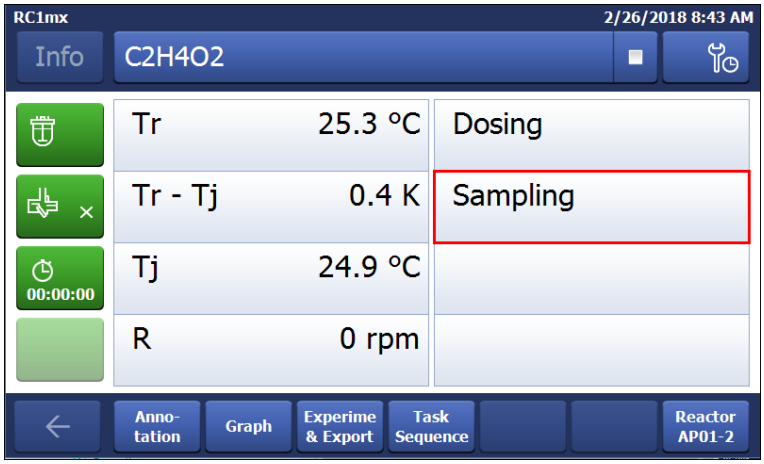


1 Tap on **Sample** on the mainscreen.

2 Change the name of the sample or use the default name.

3 Tap **OK**.

Check manual samples



1 Tap **Sample** on the main screen.

2 Tap **List** at the bottom left of the screen.

➡ All samples are shown with name and time stamp.

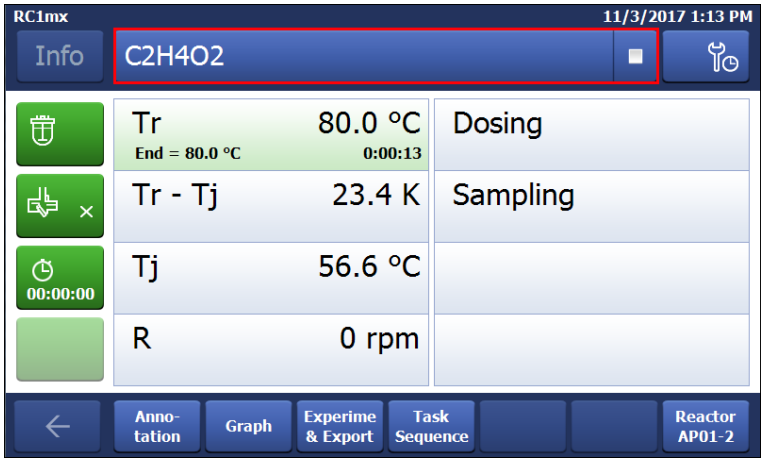
5.2.6 Manual add

1 Tap **Dose / Charge**.

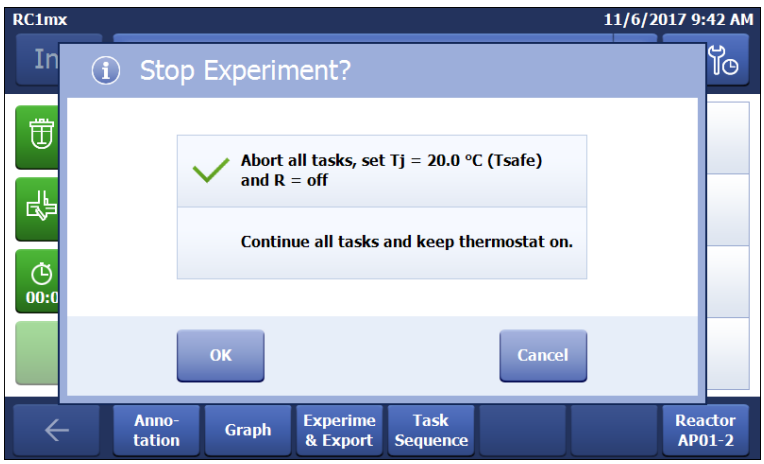
2 Select **Manual Add**.

3 Enter the correct parameters. Per default the manual add is set to dose everything at once. If you want to change that enter a duration or rate.

5.2.7 End an experiment



1 Tap on the Stop button on the mainscreen.



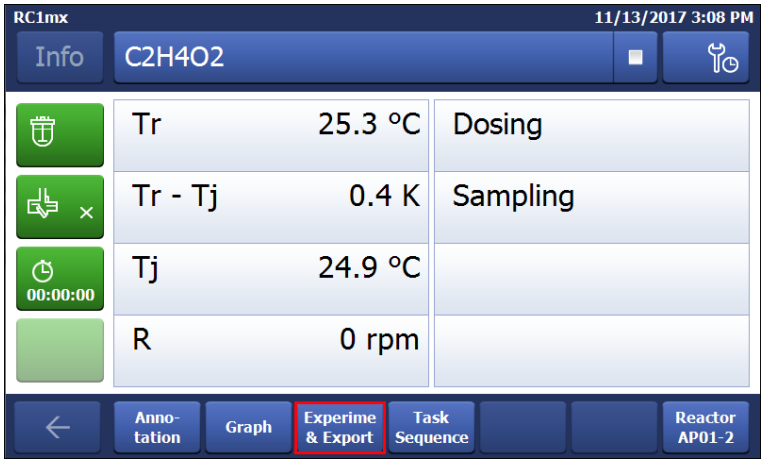
2 Select your preferred option for experiment end conditions.

3 Tap **OK**.

➡ Your experiment is stored on the device and can be exported.

5.2.8 Export data from a defined time frame

- An USB stick is inserted in the USB port.



1 Tap on **Experiment & Export**.

2 Choose **Export time period**.

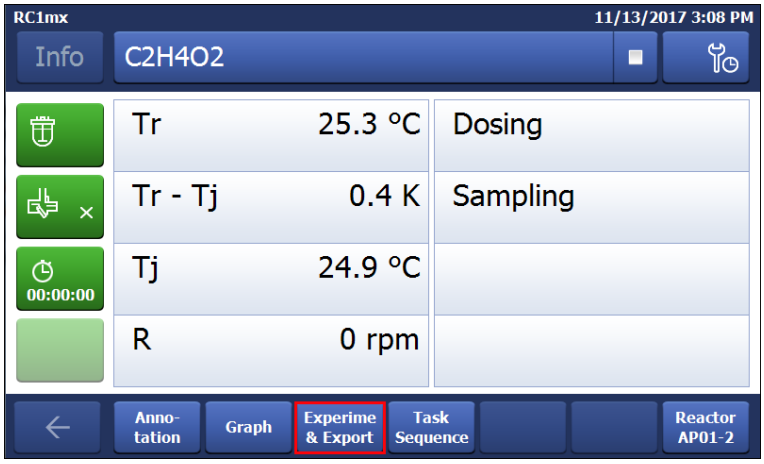
3 You can change the time period by tapping on Time period start / Time period end.

4 Tap on **Start Export**.

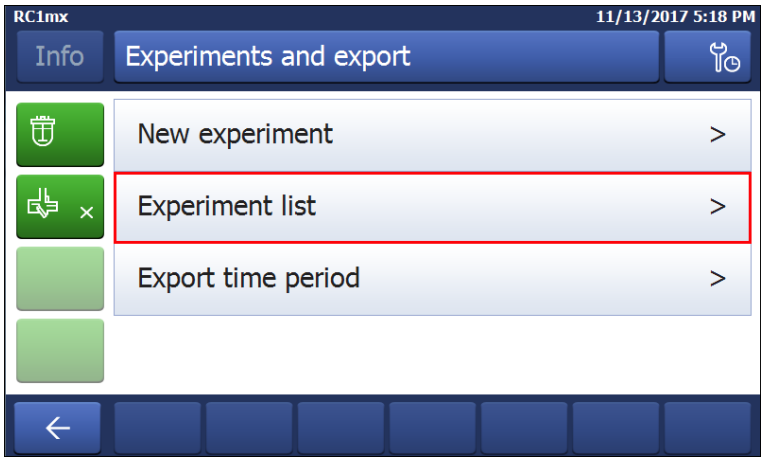
➡ The touchscreen will show a message when export is finished and successful.

5.2.9 Export single experiments

- An USB stick is inserted in the USB port.



1 Tap on **Experiment & Export**.



2 Choose **Experiment List**.

3 From the **Experiment List** choose the experiment you want to export.

4 Tap on **Start Export**.

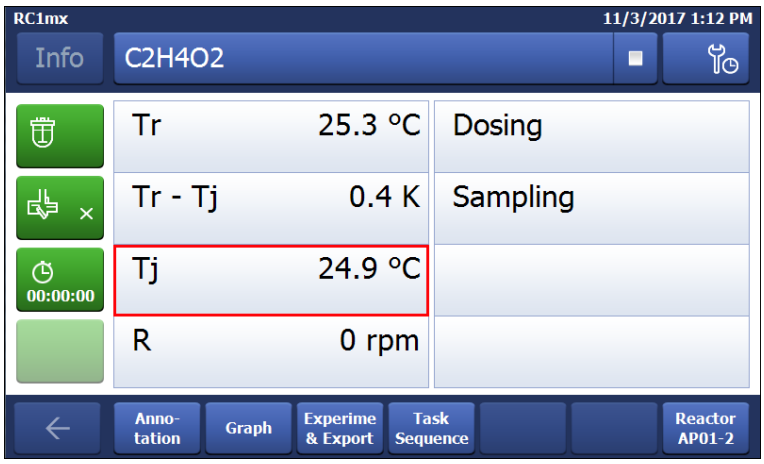
➡ The touchscreen will show a message when export is finished and successful.

Interval time can be changed in order to minimize data volume and time for export.

5.3 Heating and cooling

5.3.1 Change Tj

Note The value cannot be higher than the safety limit value.



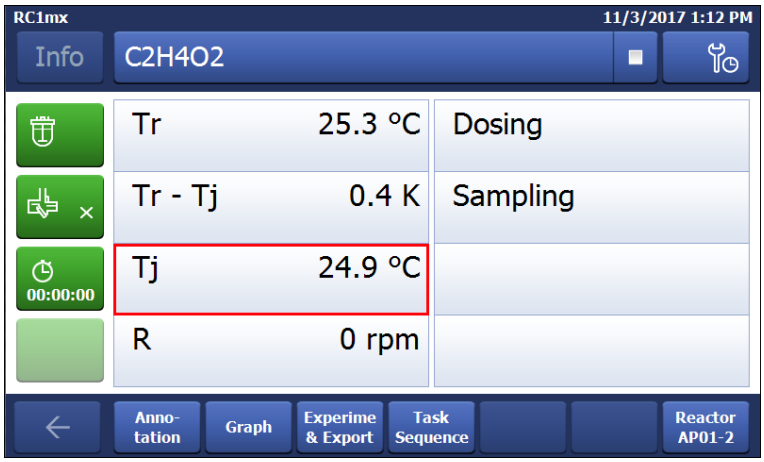
1 Tap the **Tj** value field on the main screen.

2 Enter the end temperature for **Tj**.

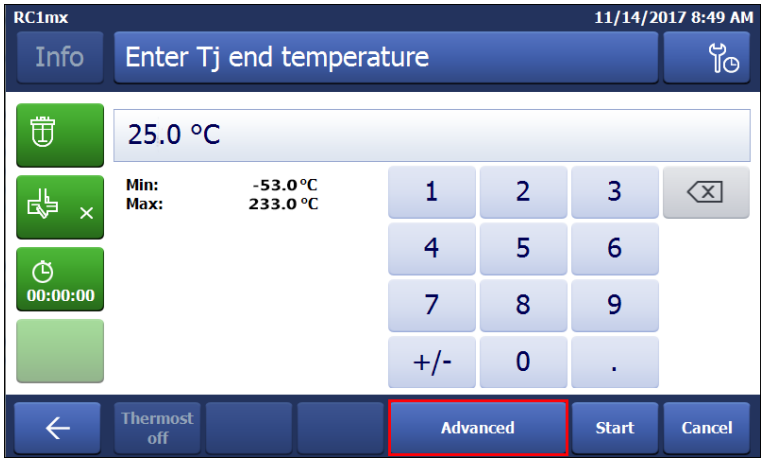
3 Tap **Start** to initiate the task.

➡ The task will start immediately.

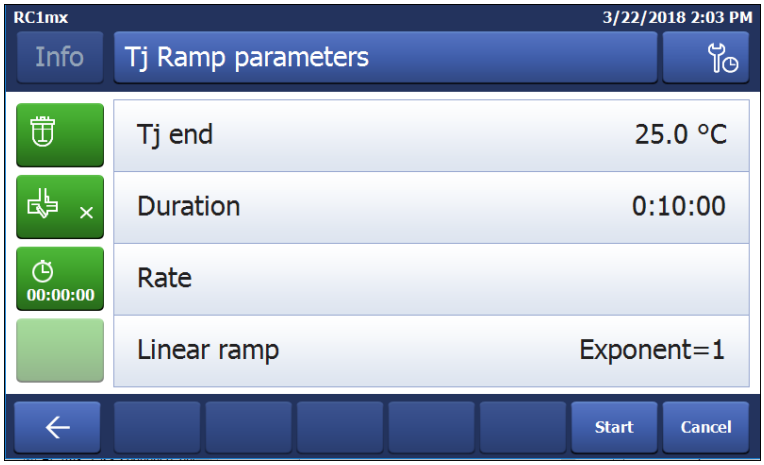
5.3.2 Create a Tj Ramp



1 Tap the **Tj** value field on the main screen.



2 Tap **Advanced** to enter the ramp settings.



3 Enter the end temperature for **Tj**.

4 You can chose between **Duration** or **Rate**.

5 Tap **Start** to initiate the task.

➡ The Tj ramp will start immediately.

Using the task sequence, you can also have your ramp starting at a certain point in the reaction.

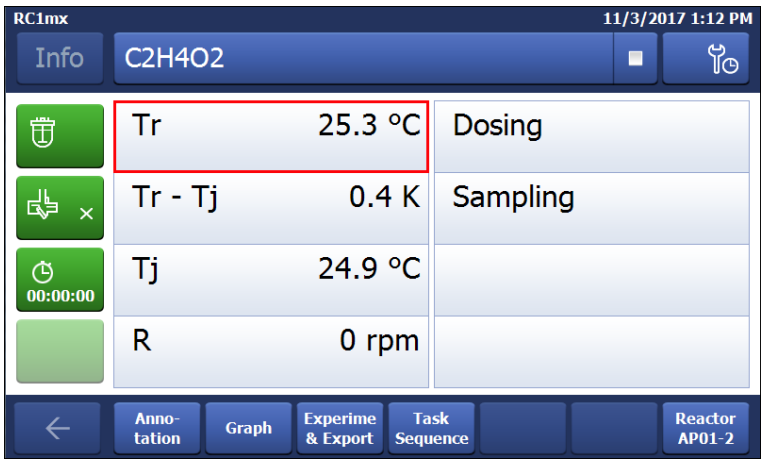
Parameters	Description
Tj end	Defines heating or cooling the reactor jacket over a certain duration or by rate.
Duration	Defines the end temperature at the end of the timespan you have entered.
Rate	Defines the end temperature is reached through the centigrade per minute you have defined.

Linear ramp	The exponent defines the shape of the curve, you can get an estimate of how the curve will look from the graphic.

5.3.3 Change Tr

Note The value cannot be higher than the safety limit value.

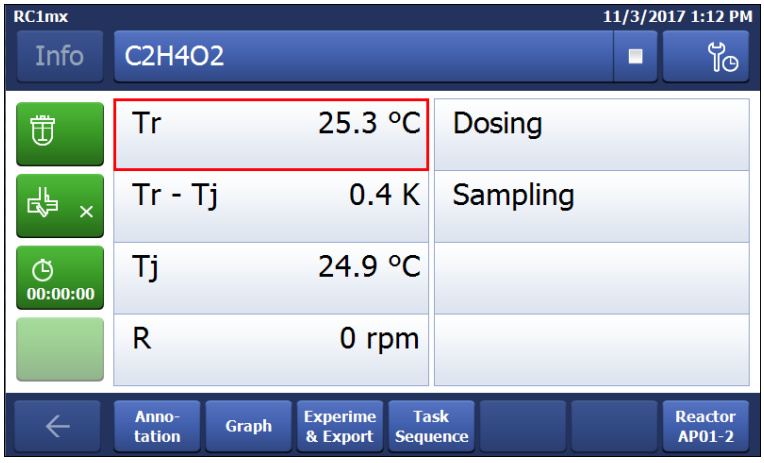
- A Tr sensor is connected to the thermostat.



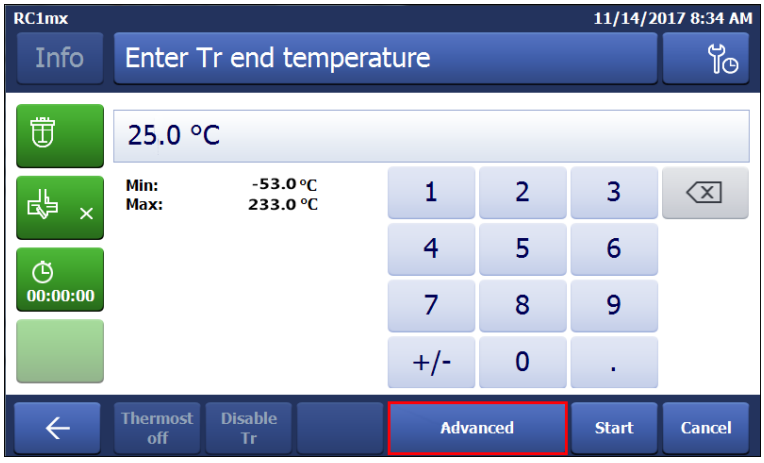
1 Tap the **Tr** value field on the main screen.
2 Enter the end temperature for Tr.
3 Tap **Start** to initiate the task.

5.3.4 Create a Tr Ramp

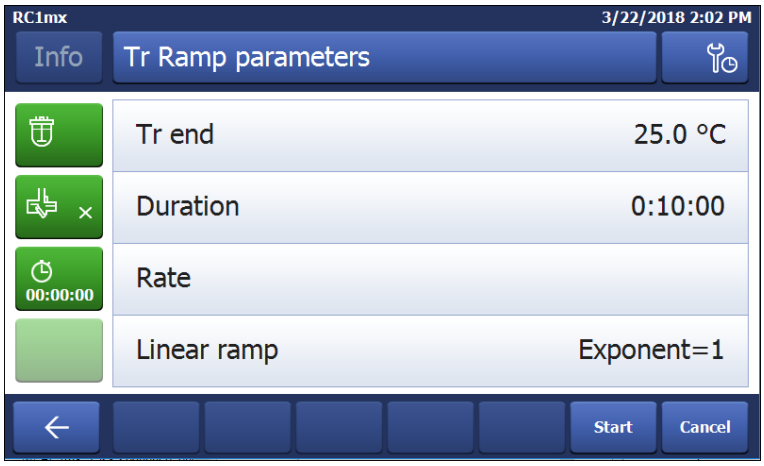
- A Tr sensor is available.



1 Tap the **Tr** value field on the main screen.



2 Tap **Advanced** to enter the ramp settings.



3 Enter the end temperature for Tr.

4 You can chose between **Duration** or **Rate**.

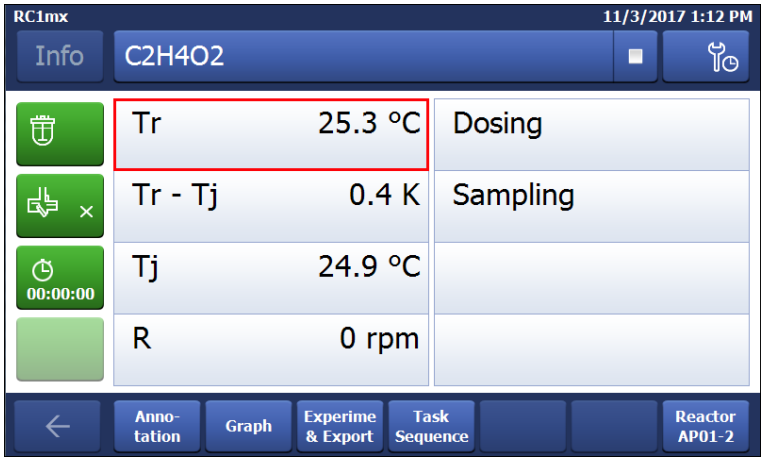
5 Tap **Start** to initiate the task.

➡ The Tr ramp will start immediately.

Parameters	Description
Tr end	Defines heating or cooling the reactor jacket over a certain duration or by rate.
Duration	Defines the end temperature at the end of the timespan you have entered.
Rate	Defines the end temperature is reached through the centigrade per minute you have defined.
Linear ramp	The exponent defines the shape of the curve, you can get an estimate of how the curve will look from the graphic.

5.3.5 Disable Tr

The Tr sensor can be disabled. Disabling the Tr sensor will also disable the Reflux / Distillation mode.



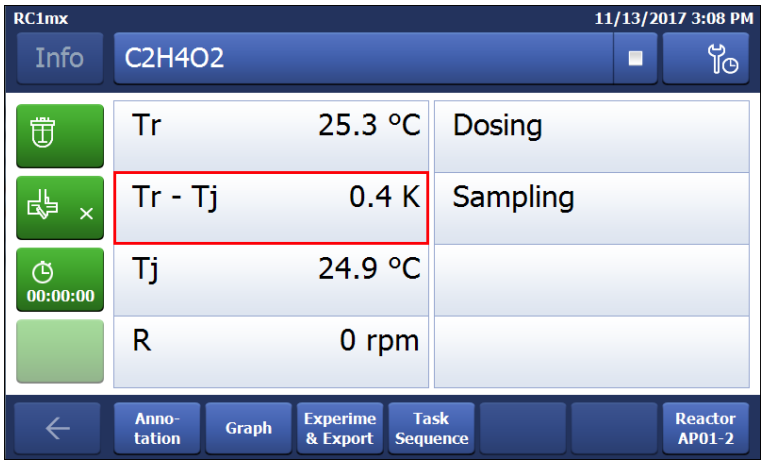
1 Tap the **Tr** value field on the main screen.

2 Tap **Disable Tr**.

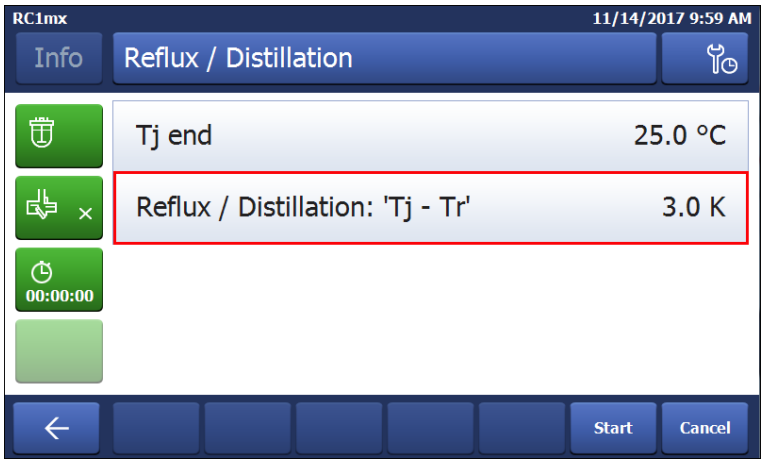
➡ The Tr sensor is now disabled and will no longer show values.

5.3.6 Create a distill / reflux operation

- Tr sensor has to be connected and enabled.



1 Tap the Tr-Tj field.



2 Enter a Tj end temperature.

3 Tap **OK**.

4 Tap **Distill / Reflux** and enter a Tj-Tr value appropriate for your reaction. For more details [Distill / Reflux mode (Tj-Tr) Page 20]

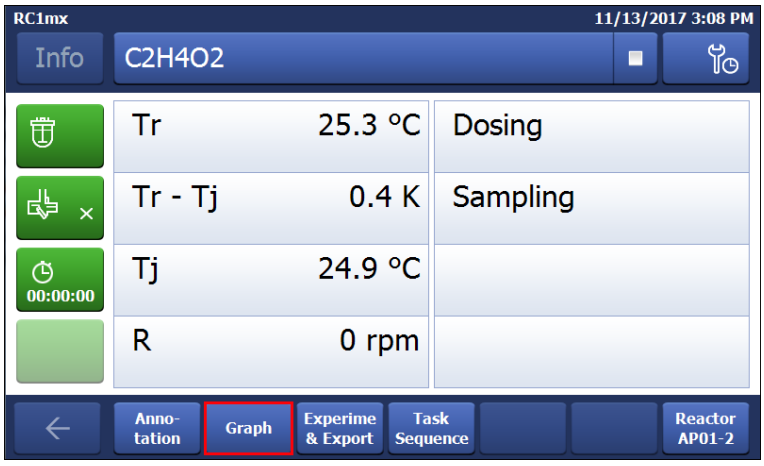
5 Tap **OK**.

6 When all parameters are entered correctly tap **Start**.

➡ The action will start immediately.

5.4 Trend graph

5.4.1 Enter trend graph screen



– Tap on the **Graph** button.

➡ The trend graph viewer is displayed.

5.4.2 Select trend graph

You can display four trend graphs in the trend graph viewer.

1 Tap on one of the parameters in the upper part of the trend graph viewer.

2 Tap on **Shown trend** to change the displayed trend.

3 Select the trend you want to display.

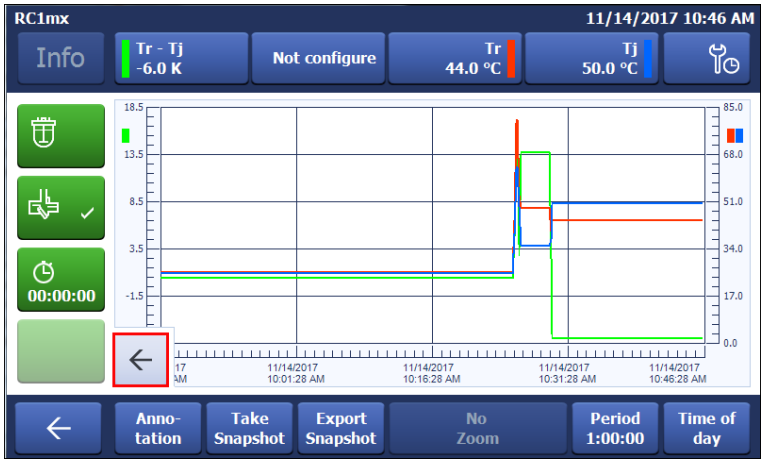
4 Tap **Apply** to display the trend graph.

5.4.3 Navigation in trend graphs

In the graph you can navigate in two ways:

- Going left or right on the time axis
- Zooming

Navigation on time axis



– Use the arrows to navigate on the time axis.

Zooming

1 Touch the screen with your finger and move it diagonally on the area you want to zoom on the graph.

2 To end the zoom tap **No zoom** to return to the normal view.

5.4.4 Add notes in trend graph view

1 Enter the trend graph view.

2 Tap on **Note**.

3 Enter your note.

4 Tap **OK**.

➡ Notes are shown on the trend graph as red triangles.

Adding a note in the trend graph screen

1 Tap on the trend screen where you want to have the note.

2 Choose **Note**.

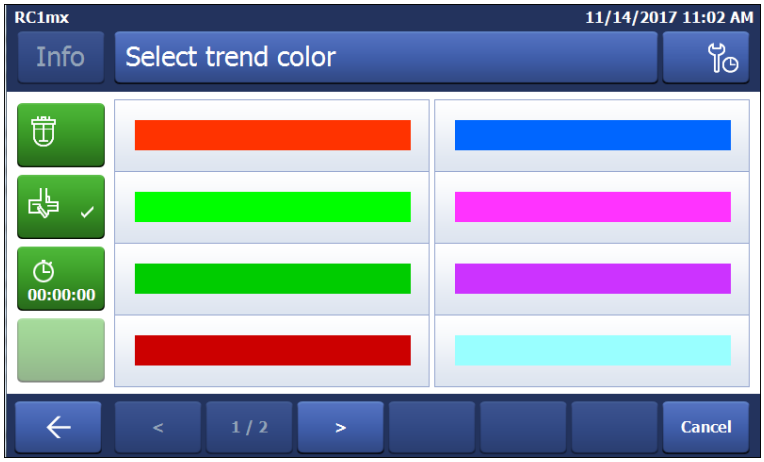
3 Enter your note.

4 Tap **OK**.

➡ Notes are shown on the trend graph as red triangles.

5.4.5 Change color of trend graphs

1 Tap on the trend graph that you want to change.



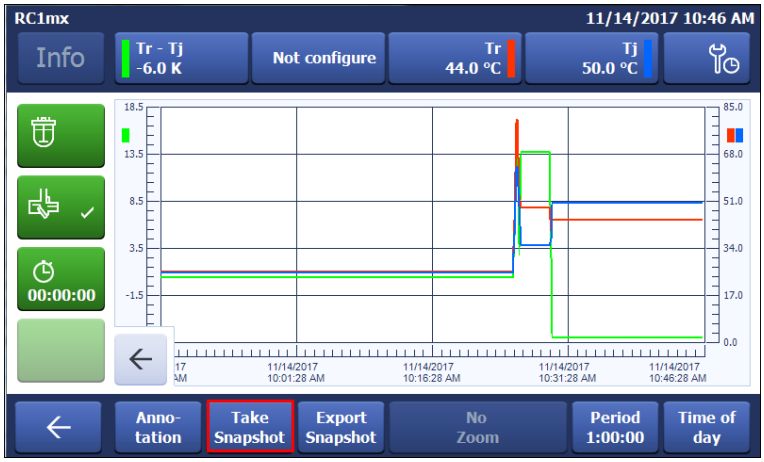
2 Tap on **Color**.

3 Select the new color of the trend graph.

4 Tap on **Apply**.

5.4.6 Take snapshot

The snapshot is taken from the whole trend graph area, if you want to have a specific part of the experiment as a snapshot you can use the zoom function.



– Tap on **Take Snapshot**.

5.4.7 Export snapshot

- An empty USB stick is inserted.

1 Tap **Export Snapshot**.

2 Select the Snapshot you want to export from the list.

➡ The Snapshot is stored on the USB stick.

5.4.8 Experiment time and time of day

You can choose between two time displays:

- Time of day
- Relative time

– You can toggle between the two time displays by tapping the button on the right bottom of the screen.

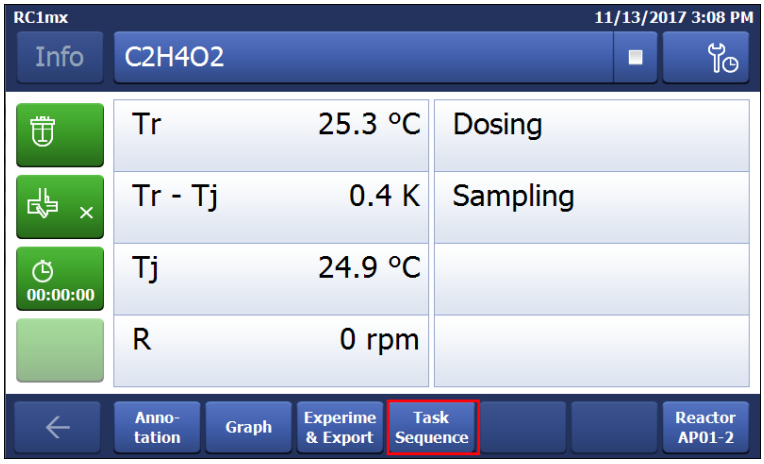
5.5 Task sequence

5.5.1 Preparing a task sequence

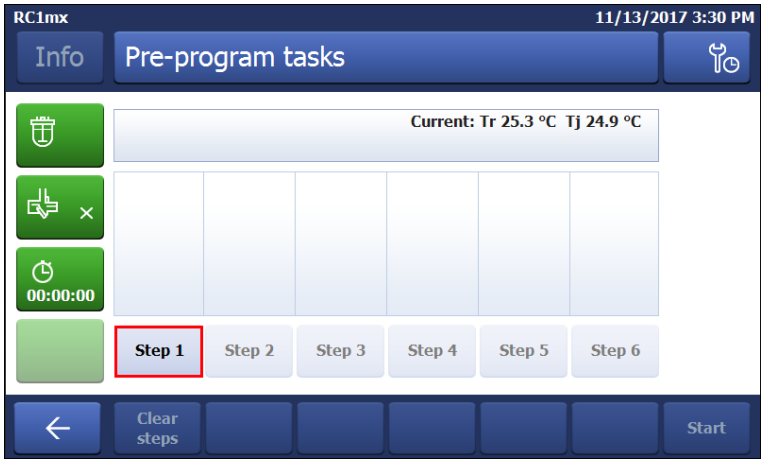
It is possible to preprogram a task sequence with up to 6 steps.

The following operations can be used:

- Tr (only if connected)
- Tj
- Tr - Tj
- R
- Wait
- Dosing with a DU SP-50 (only if connected)
- Dosing via an ECB (only if connected)

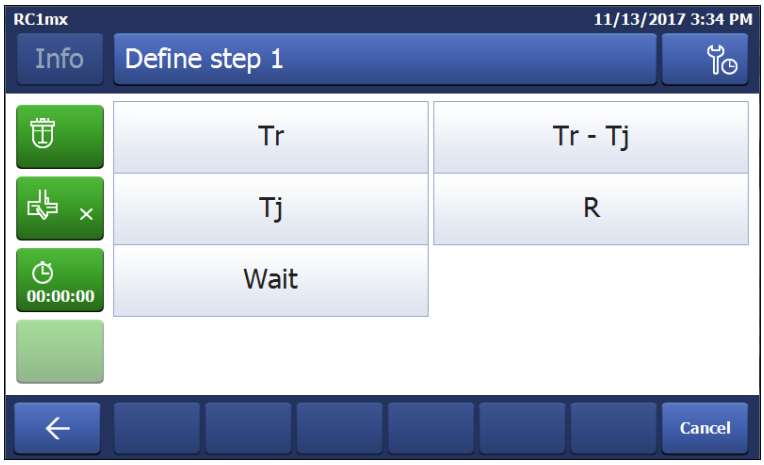


1 Tap on button **Task Sequence**.



2 Tap on button **Step** 1.

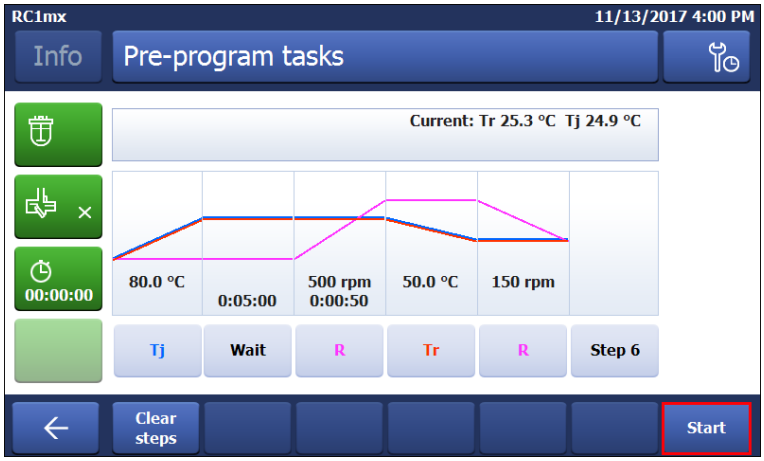
3 Choose an action from the list of parameters.



4 Enter desired values for the parameter.

5 Tap **OK.**

6 Repeat as often as needed or up to 5 times.

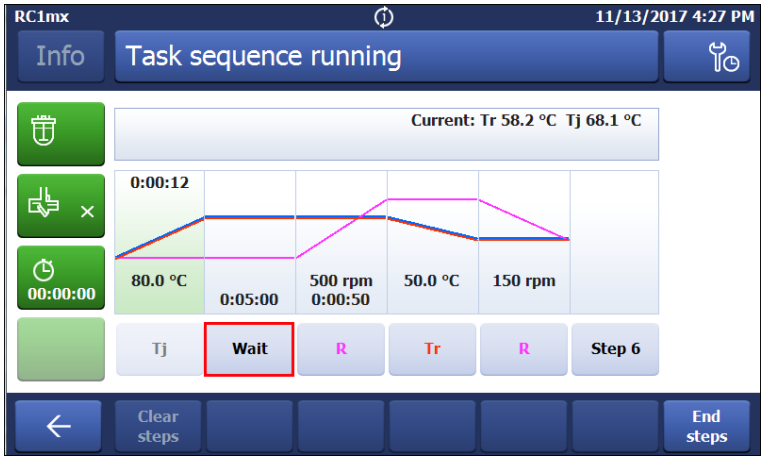


7 Tap **Start** to initialize your task sequence.

➡ The **Task Sequence** will start immediately.

5.5.2 Edit steps in a task sequence

You can edit a step as long as it has not run yet or is not active.



1 Tap on the step you want to change.

2 Select the correction task from the list.

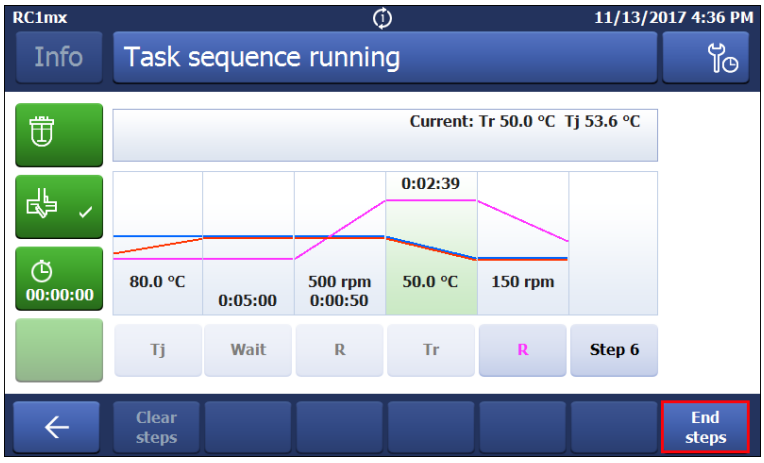
3 Enter the correct parameters for your experiment.

4 Tap on **OK**.

➡ The edited step is shown in the **Task sequence**.

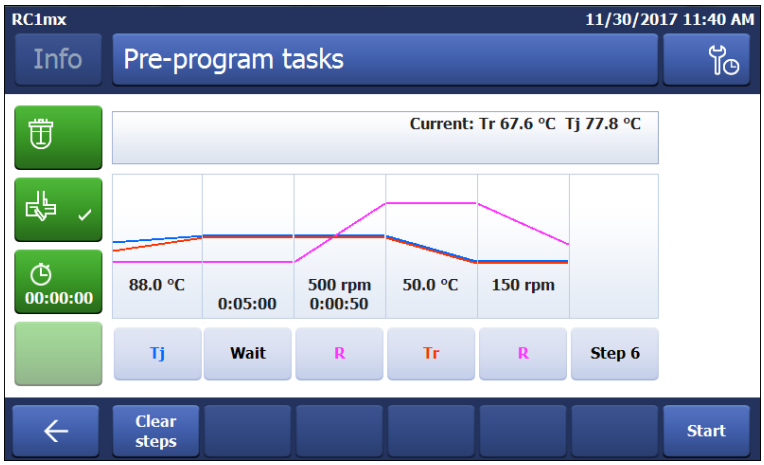
5.5.3 End a task sequence

- The task sequence is running.



– Tap in the task sequence window on the **End Steps** button.

➡ The sequence will stop immediately.



– You can reactivate the steps by pressing start or delete all steps by pressing clear steps.

5.6 Settings

5.6.1 Change network settings

This function may be needed if you want to connect the instrument to the software.

The DHCP allows to automatically integrate a device into an existing network without manual configuration. When the system is started, it obtains the IP address and the subnet mask from the DHCP server.

If a DHCP server is not available, the IP address and the subnet must be manually entered.

Note Instruct the person responsible for IT to make the following settings.

For further details on how to connect the device to the network, please also check the iControl Quick Install Guide (51710672)

1 Tap .

2 Tap on **System Settings**.

3 Tap on **Network settings**.

4 Select IP-Address to enter the IP-address manually. In case DHCP is enabled, a warning screen asks you to disable it.

5 Enter the IP-Address and confirm it with **OK**.

6 Select Subnet Mask and enter the subnet mask.

7 Confirm your entry with **OK**.

The following icons appear in the statusbar when the device is connected to applications or a data export is in progress.

Icon	Description
	Export of experiment currently executed. This icon represents an export through USB or LAN
	iControl connection established
	iC Data Center connection established

5.6.2 Change time settings

You can change different parameters:

- Date and time
- Time zone
- Date format
- Time format

NOTICE

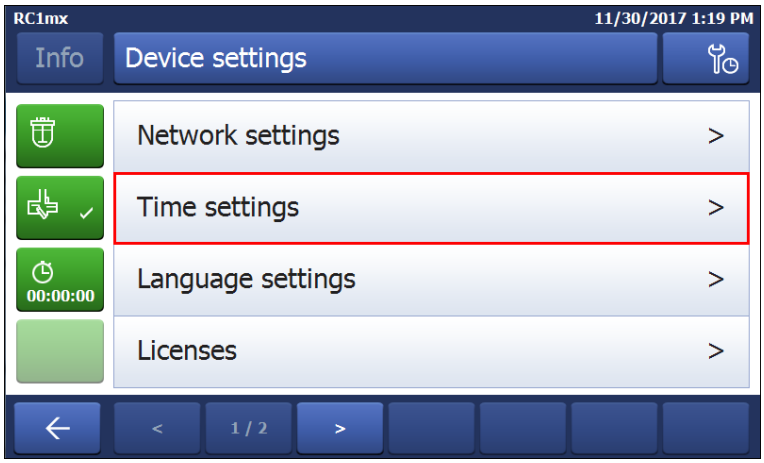
Changing time settings

Changing the Time zone or Date and Time can lead to loss of experiment data. A warning on the touchscreen will appear.

– Make sure you have exported your experiment data.

1 Tap .

2 Tap on **System settings**.



3 Tap **Time settings**.

4 Select the time setting you want to change.

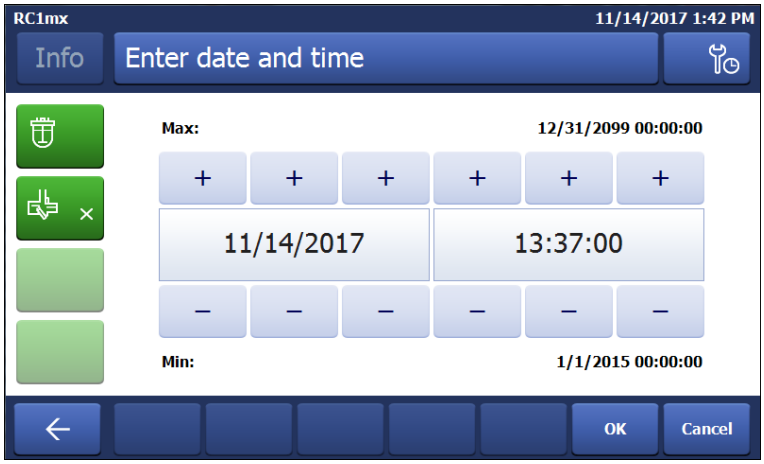
5.6.2.1 Change date and time

NOTICE

Changing time settings

Changing the Time zone or Date and Time can lead to loss of experiment data. A warning on the touchscreen will appear.

– Make sure you have exported your experiment data.



1 Tap on **Date and time**.

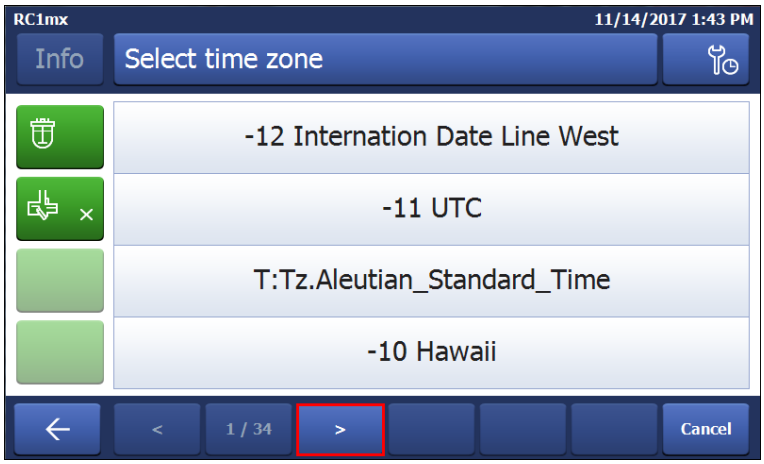
2 You can change the values by tapping on the plus and minus buttons.

3 Tap **OK**.

4 Tap **Apply** if you have saved your data.

5.6.2.2 Change time zone

1 Tap on **Time zone**.

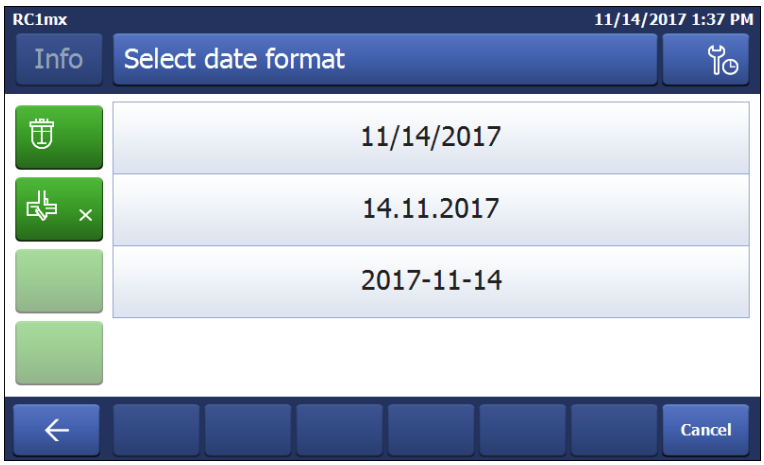


2 Select the time zone you are in. You can go through the pages by tapping the arrow button.

3 Tap **Apply**.

5.6.2.3 Change date format

1 Tap on **Date format**.



2 Choose one of the formats.

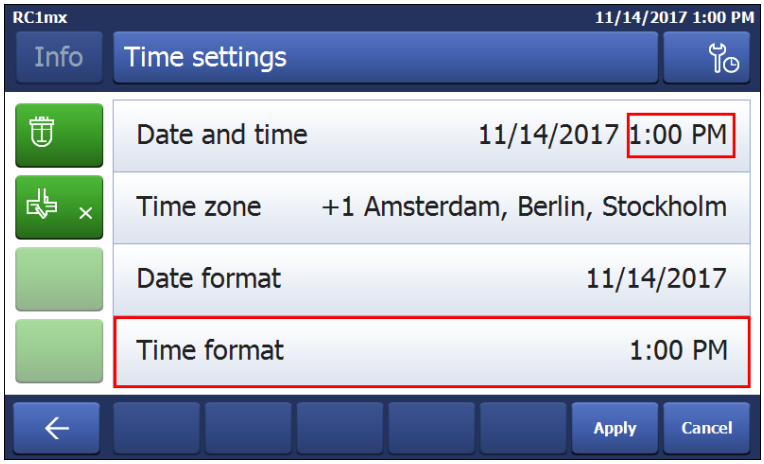
3 Tap **Apply**.

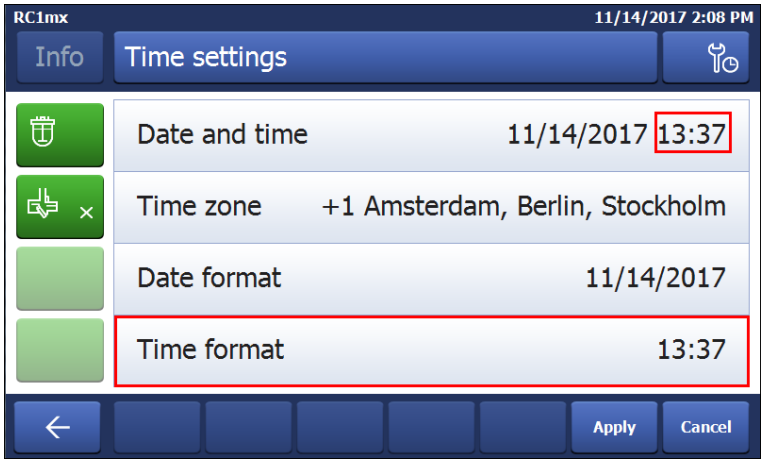
➡ The date format is changed. This change has no influence on the data storage.

5.6.2.4 Change time format

1 Tap on **Time format** to toggle between the English version with AM/PM or the standard version with just the numbers.

2 If you change the Time format, the display of Date and Time will be updated accordingly.

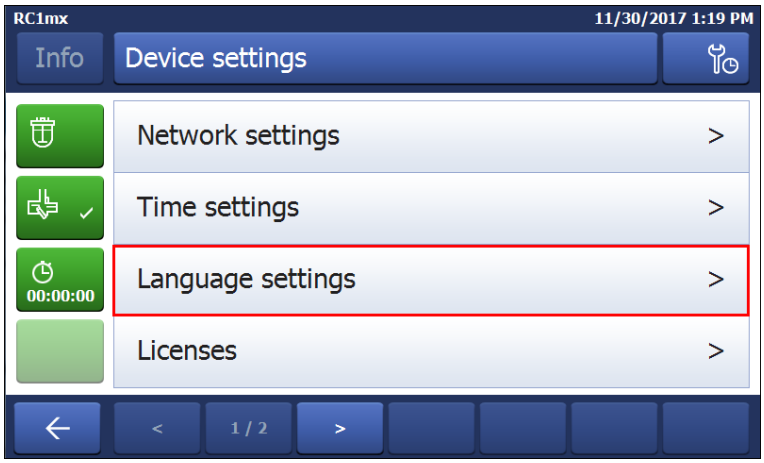




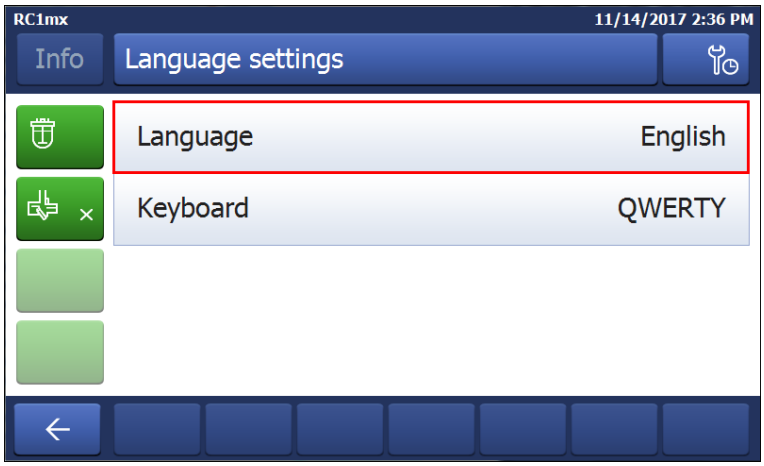
5.6.3 Change language

1 Tap .

2 Tap on **System settings**.



3 Tap **Language settings**.



4 Tap **Language**.

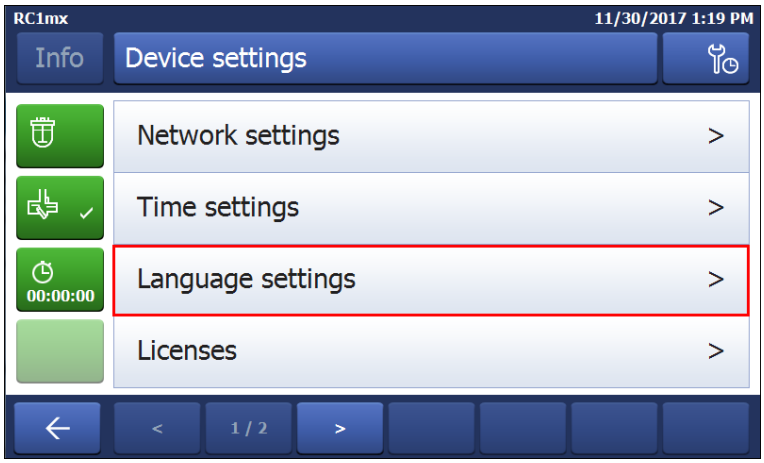
5 Select the desired language. The following languages are available:

- English
- German
- Spanish
- French
- Japanese
- Chinese

5.6.4 Change keyboard layout

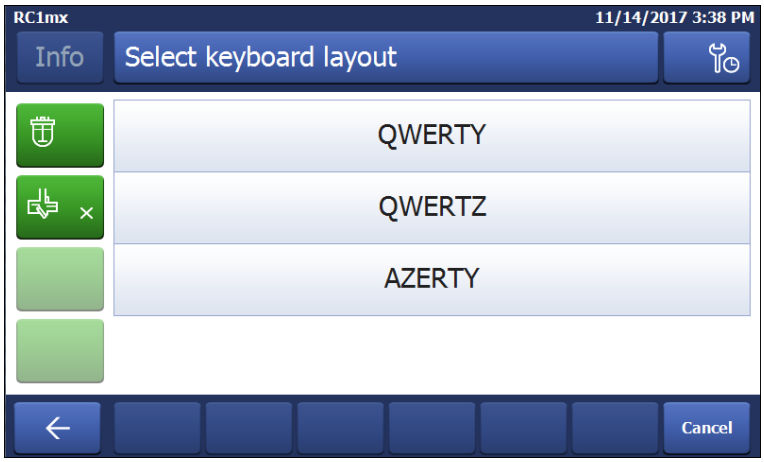
1 Tap .

2 Tap on **System settings**.



3 Tap **Language settings**.

4 Tap on **Keyboard**.



5 Choose one of the three layouts.

➡ The setting is automatically applied.

5.6.5 Activating licenses

You can activate licenses on the touchscreen under the system settings. The following types are available:

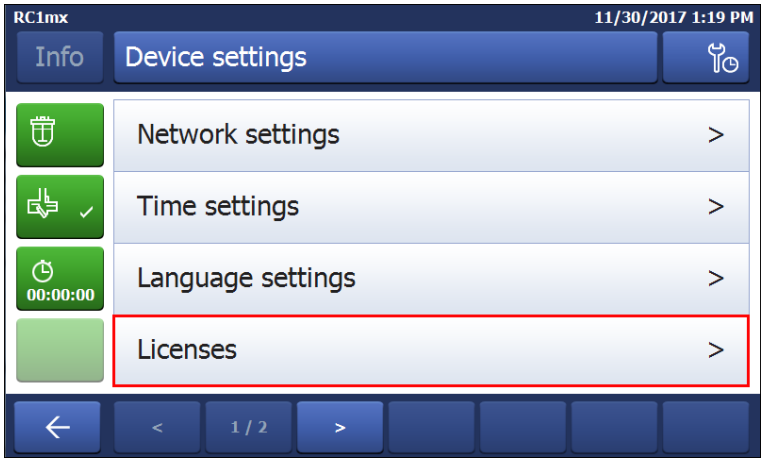
- HFCal
- QuickCal
- RTCal

To activate a licence proceed as follows:

1 Tap on .

2 Tap on **System settings**.

3 Tap on **Licenses**.



4 Tap on the type you want to activate.

5 The activation of the licenses has to be done via the Autochem comunity page.

5.6.6 System information

1 Tap .

2 Tap on **System settings**.

3 Tap **System Information**.

4 The following information are displayed:

- Firmware version
- Serial number
- Machine ID

5.6.6.1 Export logfiles

Exporting log files can be necessary if a problem with the device occurs. This helps our support to evaluate the problem.

- An USB stick is inserted in the device.

1 Tap .

2 Tap on **System settings**.

3 Tap **System Information**.

4 Tap the button **Export log files**.

5.7 Turn off Device

Proceed as follows to turn off the device:

1 Tap the Standby hardkey on the terminal. Check chapter [Operation Modes Page 20] to know the behavior of the standby mode.

2 Switch the device ON/OFF button to the OFF position.

6 Maintenance

6.1 Update Firmware

The latest firmware versions and instructions for installation are available on the following website:
https://community.autochem.mt.com/?q=software

6.2 Checking the Reactor

To check the reactor vessel for possible damage (scratches and cracks), it must be empty, clean, dry and open. Small hairline cracks can be detected by refraction using an additional light source (focused, not dispersed light).

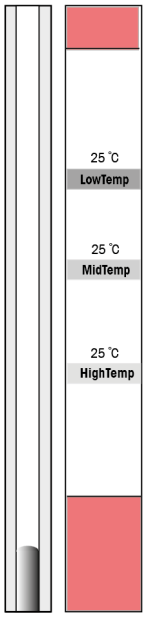
6.3 Unmount Reactor

Detailed instructions about unmounting a specific reactor are in the respective Operating Instructions.

6.4 Heat Transfer Oil

6.4.1 Check Oil Level

1 Check the oil level window.
2 The liquid level should be according to oil type.



6.4.2 Adjust Oil Level

It could become necessary to adjust oil level for example with changes in reactor volumes:

Should you encounter repetitive low level alarm, check all the connections for leakage, should they all be sealed tight and the level ok, inform your local support.

- Larger reactors may need more oil so you have to add oil.
- Smaller reactors may need less oil so you have to drain oil.

Add oil

- Make sure device is turned off.

1 Connect the oil tank to the oil drain and open the stopcock on the oil connection.
2 Add oil until it has reached the correct level for the specified oil type.
3 Check the oil level window for the level.
4 Close the stopcock again and turn on device.

Drain oil

- Make sure the device is turned off.

1 Connect the oil tank to the oil drain and open the stopcock on the oil connection.
2 Drain oil until it has reached the correct level for the specified oil type.
3 Check the oil level window for the level.
4 Close the stopcock again and turn on device.

6.4.3 Exchange Oil

⚠ WARNING

Wrong oil type selected

– Select the oil type corresponding to that actually used in the RC1mx!
➡ Other oil types could lead to a malfunction of the safety system.

⚠ CAUTION

Risk of explosion due to wrong heat transfer oil

The solubility of the antistatic additive and therefore the protection against electrostatic discharges cannot be guaranteed with the wrong heat transfer oil.

– Only use heat transfer oils specified by METTLER TOLEDO.

An oil exchange is required when:

- it is cloudy or discolored
- you change the oil type in order to work in a different temperature range.

Proceed as follows to perform an oil exchange:

- Make sure you have already mounted the reactor you want to use after the oil exchange.
- Make sure the heat transfer oil (Tj) has reached room temperature.
- Emergency button is released.

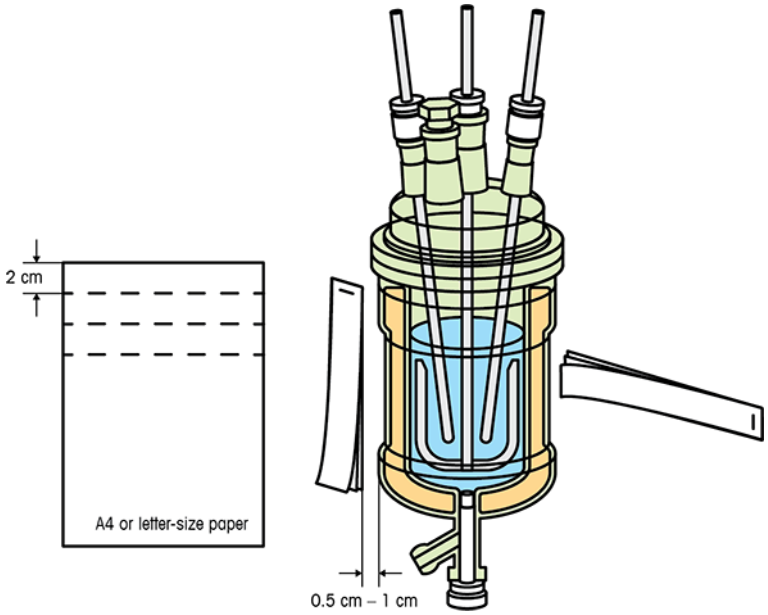
1 Switch off the RC1mx.
2 Connect the tubing to oil draining cock on the side of instrument.
3 Prepare an empty oil container with 10L volume.
4 Place it on lower level than the instrument so that oil can flow.
5 Open the oil drain stopcock.
6 Wait until the oil flow stops.
➡ If necessary disassemble the reactor; remove all traces of oil from double jacket and reassemble the reactor.
7 Should you change the oil type you need to exchange the O-rings on the reactor connections.
8 Close the oil drain stopcock.
9 Connect the new oil to the oil drain stopcock and open it.
10 Place oil container on a higher level than the instrument.
11 Refill the device with the new heat transfer oil (9.5 liter oil and 250 mL antistatic additive) until the lower red marking is exceeded.
12 Slowly add the oil up to the correct marking.
13 Close the oil drain stopcock.
14 Use the oil type switch to choose the correct oil type.
15 Switch on the RC1mx.
➡ When switching on the RC1mx the touchscreen will show a manipulation warning which you have to acknowledge or decline.
16 Allow the oil to circulate for approx. 5 minutes to check whether the oil level changes after switching on the pump due to trapped air bubbles.

17 Enter the appropriate value for Tj (HighTemp/MidTemp oil = 100 °C or LowTemp oil = 50 °C) on the touchscreen.

18 Let it run for about 10 minutes to drive off all air bubbles.

6.4.4 Check Antistatic Conditions

The electrostatic charging can be shown by a simple test with paper strips, which are repelled by an electrostatic charge. Perform this check at regular intervals to ensure safe operation.



1 Cut out 3 paper strips 2 cm x 16 cm from a sheet of photocopy paper.

2 Staple the 3 strips together at one end.

3 Heat the reactor in the Tj mode to 50 °C and wait at least 30 minutes.

4 Remove the protective shield of the reactor.

5 Hold the paper strips at the stapled end vertically at a distance of 0.5 to 1.0 cm and at right angles to the outer wall of the reactor.

➡ If the loose paper ends fan out by more than 3 cm, the electrostatic charge is so large that more antistatic additive has to be added.

6.4.5 Restoring Antistatic Conditions

⚠ CAUTION

Risk of explosion due to wrong heat transfer oil

The solubility of the antistatic additive and therefore the protection against electrostatic discharges cannot be guaranteed with the wrong heat transfer oil.

– Only use heat transfer oils specified by METTLER TOLEDO.

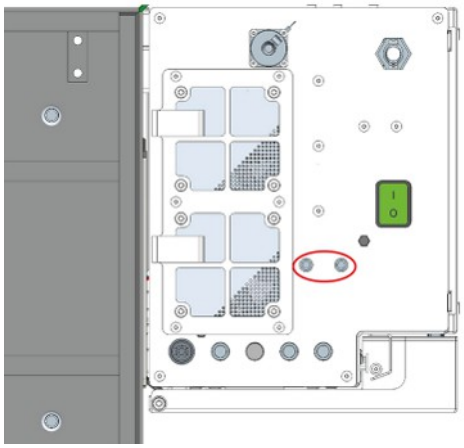
If electrostatic charging occurs, you must add an additional 250 mL antistatic additive without changing the oil.

1 First empty about 2 liters of the heat transfer oil into the oil container and mix this quantity with 250 mL antistatic additive.

2 Add oil until the level corresponding to the oil type used is reached again.

6.5 Connecting Purge Gas

The installation procedure is the same for the Purge-1 Oil and the Purge-2 Electronic Cabinet.



1 Attach an inert gas supply to the purge connections on the bottom of the electronics cabinet.
2 Use quick connect couplings to attach the tubes to the connections.
3 Fasten the tubes with hose clamps.
4 Use the rotameter to set the gas flow in the range of 15 % (for medium / low cooling rates up to -2.5 K/min) to 25 % (for high cooling rates up to -4 K/min).

6.6 Check Purge Gas Flow

The rotameter only indicates the purge gas flow for the oil purge.

For the purge of the electronics cabinet we recommend a flow of: 200 mL/min

1 Check the rotameter on the front side of the device.
2 If the flow rates mentioned in [Connecting Purge Gas Page 60] are not achievable, check that all connections are correct.

6.7 Cleaning the Instrument

⚠ CAUTION

Hot instrument parts

Touching hot parts of the instrument can result in burnings.

– Do not clean the instrument before all parts have reached room temperature.

NOTICE

Damage to the device due to incompatible cleaning agents

Inappropriate cleaning agents could damage the housing of the device.

1 Use the described cleaning agent.
2 Should you use other cleaning agents, ensure that they are compatible with the housing material.

The housing of the instrument is not watertight (i.e. splash proof). We therefore recommend that you clean it with a damp cloth using ethanol.

If you have questions about the compatibility of cleaning agents, contact your authorized METTLER TOLEDO dealer or service representative.

6.8 Exchange SD card

This maintenance act should only be done if advised by your support.

NOTICE

Using a non METTLER TOLEDO SD card

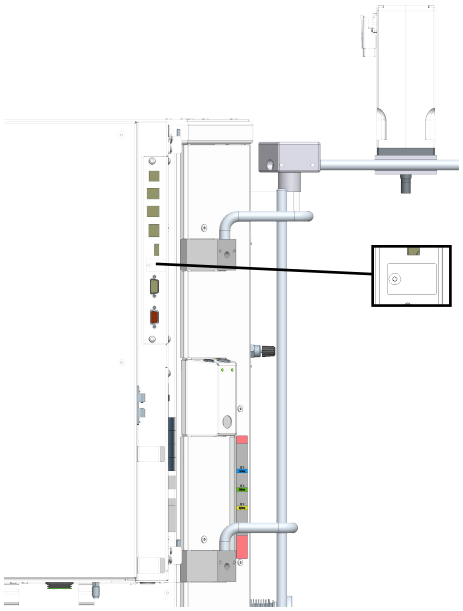
Using a different SD card than the one Mettler-Toledo GmbH provides can cause data loss or malfunction of the device.

– Only use the SD card (30317840) provided by METTLER TOLEDO.

- Device has to be switched off.

1 Open the door of the electronics cabinet.

2 Screw away the plate on the SD card slot.



3 Take out old SD card.

4 Put in new SD card.

5 Screw the plate back on the SD card slot.

6 Turn on device.

6.9 Disposal

In conformance with the European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE) this device may not be disposed of in domestic waste. This also applies to countries outside the EU, per their specific requirements.

Please dispose of this product in accordance with local regulations at the collecting point specified for electrical and electronic equipment. If you have any questions, please contact the responsible authority or the distributor from which you purchased this device. Should this device be passed on to other parties, the content of this regulation must also be related.

7 Accessories

Ask your local support for more detailed information of sellable accessories.

Oil kits

30399947	**MidTemp oil kit**	
71515	MidTemp oil, 47V20 (5 kg)	2
71514	O-ring 32.93 x 3.53 mm, Viton (oil inlets)	2
103298	Antistatic-additive (4 pcs 250 mL)	1
30399946	**LowTemp oil kit**	
51190295	LowTemp oil (4 kg)	3
51190302	O-ring, reactor/therm.,FEP-O-SEAL, LowTemp	2
103298	Antistatic-additive (4 pcs 250 mL)	1
30400338	**HighTemp oil kit**	
71569	HighTemp Oil, 47V100 (4 kg)	2
51190299	O-ring, react./thermostat, Kalrez, HiTemp	2
103298	Antistatic-additive (4 pcs 250 mL)	1

Items from the oil kits can also be ordered individually.

Stirrer motors

30395120	Standard Torque stirrer	1
30374081	High Torque stirrer	1

Sensors and probes

Check the reactor Operating Instructions for suitable Tr sensors	Tr sensors • Different materials • Different forms
Check the reactor Operating Instructions for suitable Calibration heaters	Calibration heaters • Different materials • Different heating power • Different forms

Reactors

- Glass reactors
- Glass pressure reactors
- High pressure reactors

Software

Additional purchased software or upgrade licenses are sent out electronically by e-mail.

8 Technical Data

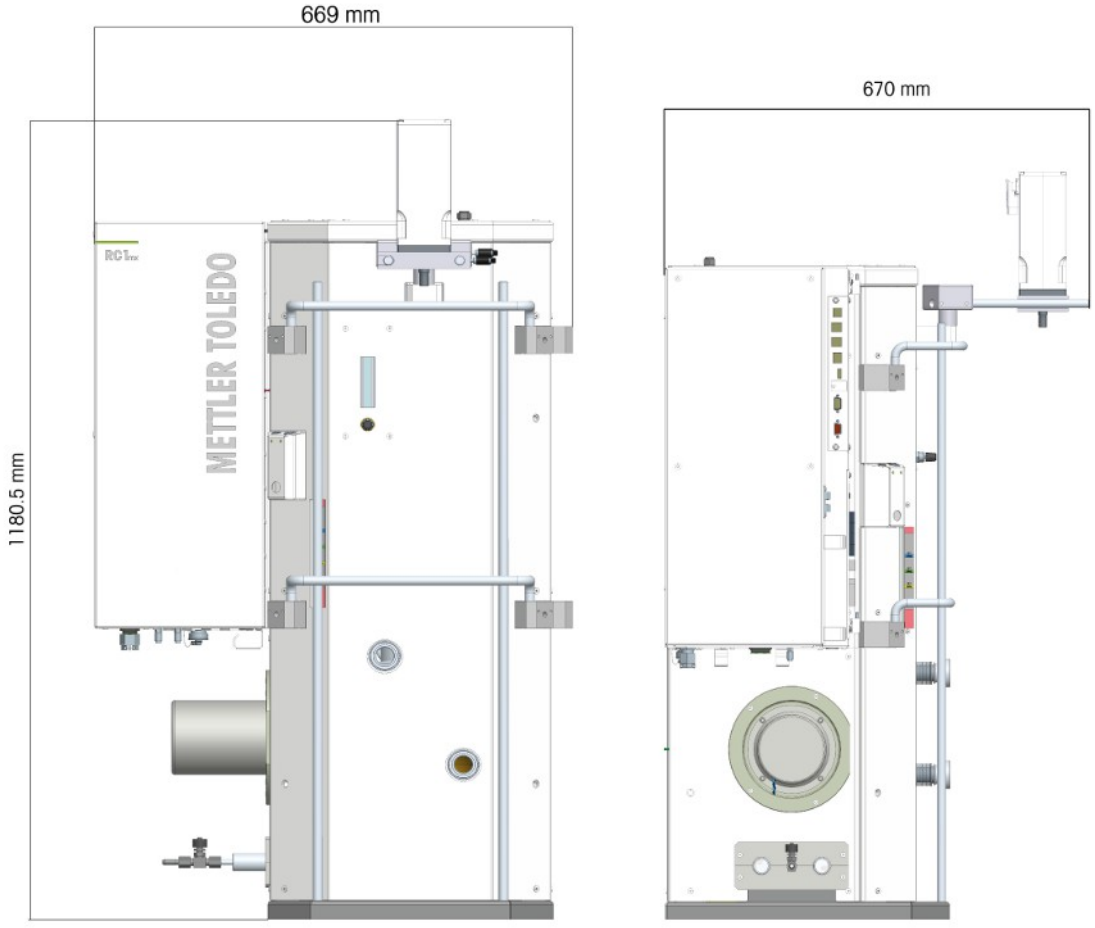
8.1 General

RC1mx (Type H)	Line voltage	350...415 V 3N~
	Permissible voltage fluctuations	Check ambient conditions
	Input frequency	50/60 Hz
	Power consumption	Max. 4800 W
	System impedance	Zmax = 0.031 Ω
	Fuses	• Motor + Heater: 4x T 10A H, 500 V fuse

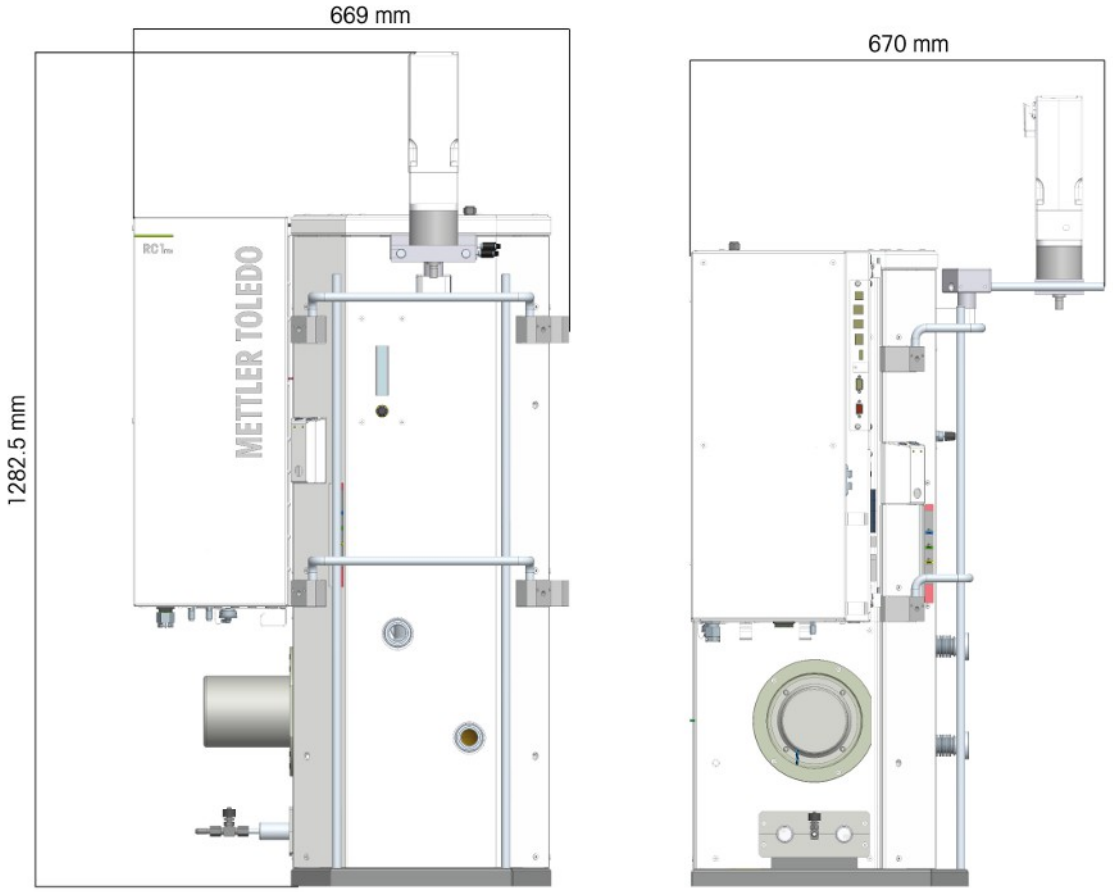
RC1mx (Type L)	Line voltage	200...240 V 3~
	Permissible voltage fluctuations	Check ambient conditions
	Input frequency	50/60 Hz
	Power consumption	Max. 4800 W
	System impedance	Zmax = 0.031 Ω
	Fuses	• Motor: 2x T 10A H, 500 V fuse • Heater: 2x T 20A H, 500 V fuse

Dimensions

RC1mx with Standard stirrer motor



RC1mx with high torque stirrer motor



Weight	170 kg

Materials

Housing	Reactor Frame Holder: Aluminium, anodized Panels: Aluminium, powder coated Frame: Steel, powder coated
Touchscreen	Crastin SO653 (PBT-GB20)
Protective cover for touchscreen	PET-A
Stirrer motor	Powder coated housing, anodized aluminum
Stirrer motor support	Flange: AlSi1MgMn Aluminium Rods: Stainless Steel 1.4301 (X5CrNi18-10) Wing screws: Stainless Steel 1.4404 (X2CrNiMo17-12-2)
Flanges	Tube: Stainless Steel 1.4541 (X6CrNiTi18-10) Flange: Stainless Steel 1.4301 (X5CrNi18-10)
Oil level window	PC
Electronics cabinet	Housing: Steel powder coated 1.0330 (DC01) Mesh: Stainless Steel 1.4301 (X5CrNi18-10)
Cover control valve	PP
Cover cooling inlet	PP
Coolant in/out connections	Stainless Steel
Spill Tray	Stainless Steel (X5CrNiMo18-10)
Connection for purge gas	Brass (CW617N)
Internal purge gas tubing	PVC, PTFE
Internal coolant line	Copper

Ambient conditions

Humidity	Max. relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C
Altitude	Up to 2000 m
Overvoltage category	II
Pollution degree	2
Ambient temperature	5 °C…40 °C
Usage	For indoor use only
Mains supply voltage fluctuations	Up to ± 10 % of the nominal voltage

8.2 Thermostat

LowTemp oil	Tj: -70 °C (with cryostat) to +80 °C
MidTemp oil	Tj: -50 (device limit) / -45 °C (oil viscosity limit) (with cryostat) to +230 °C
HighTemp oil	Tj: -5 °C (with cryostat) to +300 °C
Max. permissible errors valid for Pt100 sensor Class A	0,5 °C in the range of -20 to +100 °C 1,0 °C in the range of +100 to +200 °C
Long-term stability	± 0,1 °C
Data recording interval	Every 2 seconds

8.3 Cooling

Cooling medium	Water (unpolluted); otherwise install a filter Cryostat using: • Ethylene glycol • Ethanol • Silicone oil
Flowrate	10 L/min

8.4 Purge gas

Minimum flow	80 mL/min
Temperature range	Below room temperature and above 180 °C
Purge medium	Inert gas
Max inlet pressure	0.5 bar

8.5 Stirrer

Standard torque stirrer

Speed	1…2500 rpm (depending on stirrer type and viscosity of the reaction mass), consult the reactor manuals for suitable stirrers and stirrer speed.
Operating	Control to constant value or ramp
Types (Material)	Anchor (glass/metal), pitched-blade (glass/metal), gassing stirrer (glass), Paravisc® stirrer (metal)
Torque	Max. 1 Nm

High torque stirrer

Speed	1…625 rpm (depending on stirrer type and viscosity of the reaction mass), consult the reactor manuals for suitable stirrers and stirrer speed.
Operating	Control to constant value or ramp

Types (Material)	Anchor (glass/metal), pitched-blade (glass/metal), gassing stirrer (glass), Paravisc® stirrer (metal)
Torque	Max. 4 Nm

8.6 Connections

All electrical connections	Not limited energy
HDMI	Only compatible with METTLER TOLEDO terminal
USB	Support of USB 2.0
Cable length	Limited to 3 m for RS232, USB, CAN, DC 24 V outputs, safety relay

Safety relay

Safety relay (passive) max.	30 VDC / 1 A

Output DC 24 V 1+2 and safety relay (active)

Max. current	1 A = I_{DC1} + I_{DC2} + I_{SR}
Nom. voltage	24 V

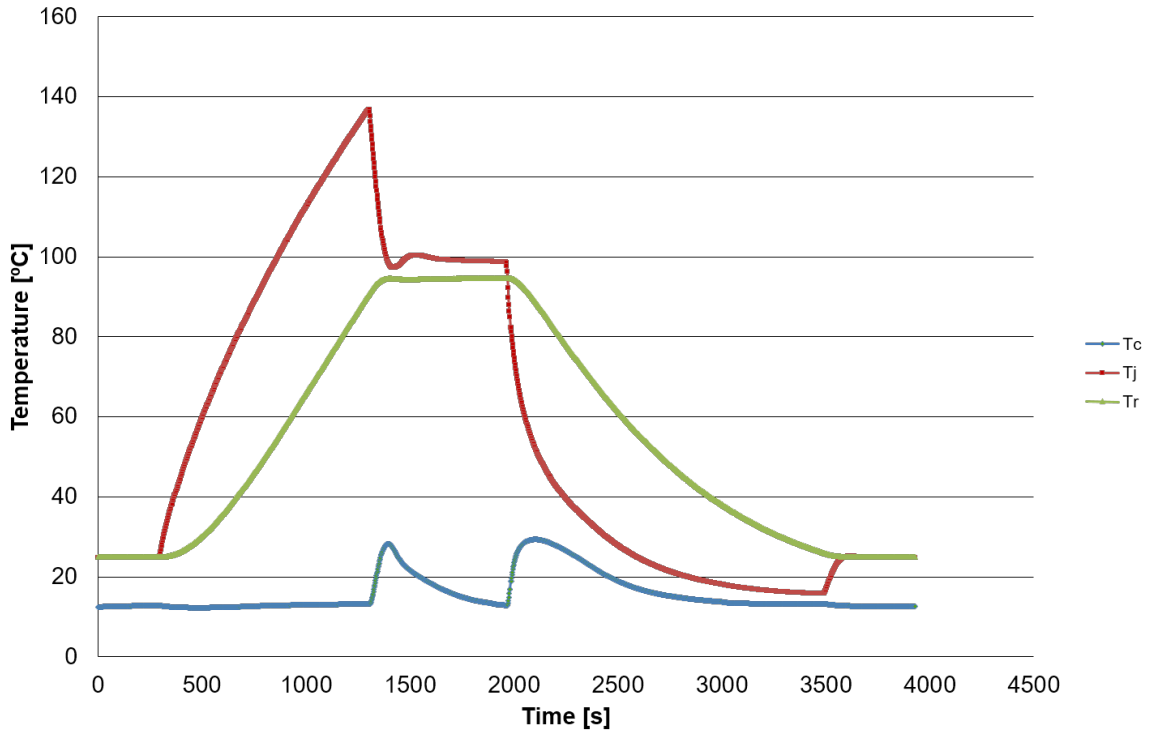
8.7 Heating/Cooling curves

This curves are an example of the cooling and heating capacities with a 2 Liter glass reactor. The curves can vary depending on the reactor and the fill height.

In these experiments a AP01-2 reactor was used together with Huber Unistat 905.

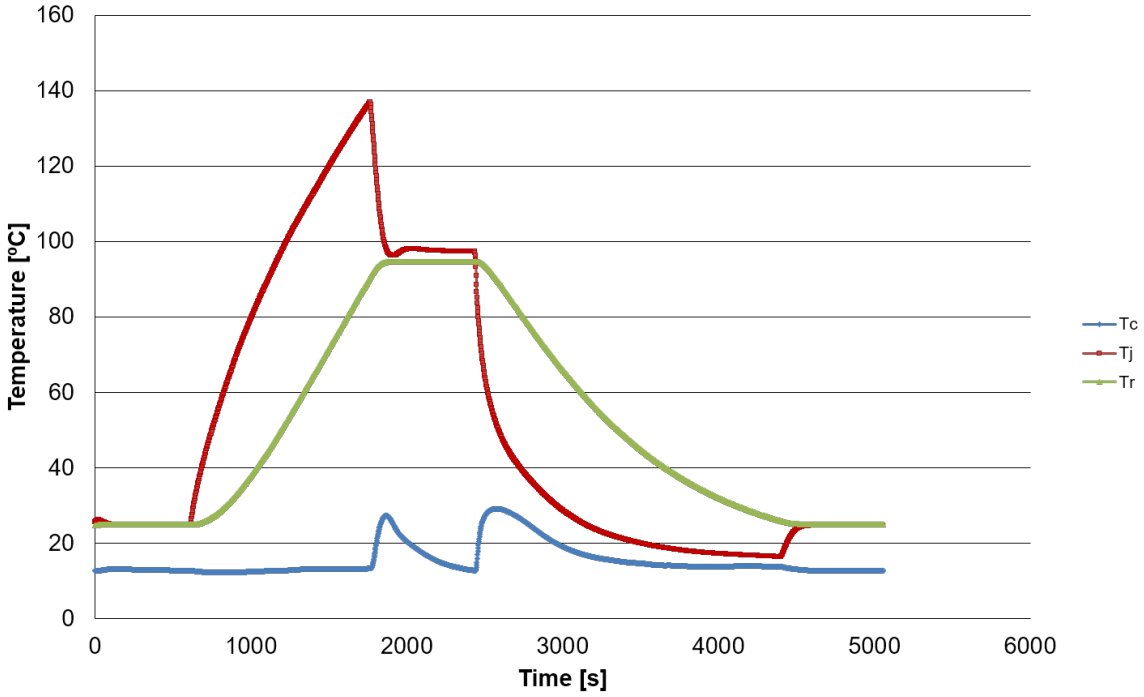
Curve 1: Maximum heating and cooling rate with 1 L water in Tr mode

Tset 25 °C → 95 °C → 25 °C, 150 rpm



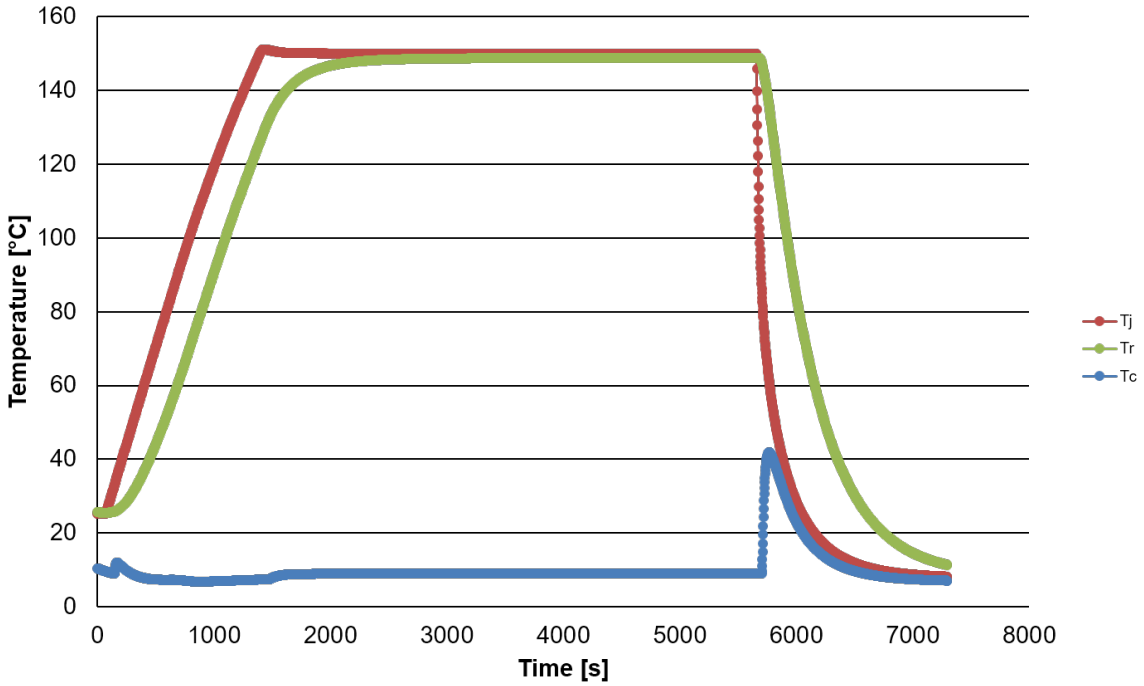
Curve 2: Maximum heating and cooling rate with 2 L water in Tr mode

Tset 25 °C → 95 °C → 25 °C, 150 rpm



Curve 3: Emergency cooling with Midtemp oil

Tset 25°C → 150 °C → lowest possible temperature, 150 rpm



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