

Frost protection for pipes

Frozen pipes can be a costly problem. When pipes are exposed to sub-zero temperatures they can burst, leading to considerable damage and disruption. The Raychem frost protection system for pipes provides an efficient solution. The self-regulating heating cable, combined with an adequate insulation, prevents water pipes, fire mains, sprinkler systems and fuel oil lines from freezing.

Thermostat with line or ambient temperature sensor

Residual current device (30 mA)
Circuit-breaker (C type)

Junction box
(JB16-02)

T-Connection (RayClic-T-02)
(Not for FS-C-2X)

Power connection (RayClic-CE-02)
(Not for FS-C-2X)

Electrical traced label
(LAB-I-01)

Frost protection heating cable
(FS-A-2X, FS-B-2X or FS-C-2X)

End seal (RayClic-E-02)
(Not for FS-C-2X)

Easy to install

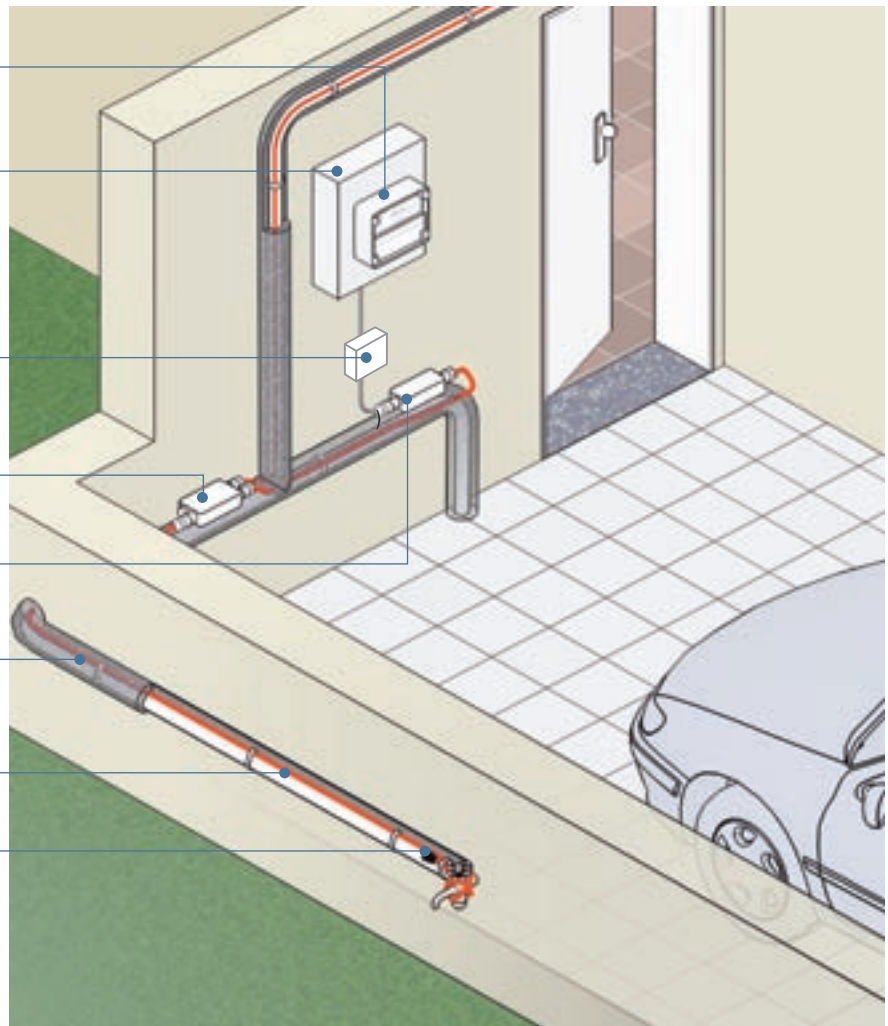
The heating cable is simply fixed on the pipe – under the thermal insulation. Connections are quickly made with the fast RayClic connectors.

Durable and reliable

The cable's large copper conductors make it a reliable solution and its specially-formulated outer jacket protect it from severe environmental conditions.

Low power consumption

Smart RAYSTAT control units calculate a duty-cycle proportional to the expected minimum temperature. Where a simple ambient thermostat would energize the heating cable for 100%, the "smart" controllers would energise for a fraction of the time, resulting in significant extra savings.



Design guide, control units and accessories

1. Heating cable selection

Application

Frost protection for pipework at max. 65°C operating temperature

FS-A-2X 10 W/m at 5°C

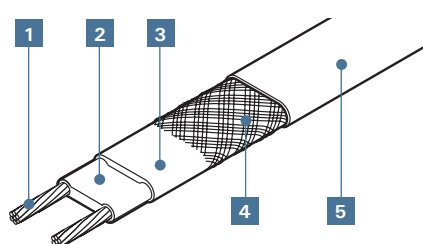
FS-B-2X 26 W/m at 5°C

Frost protection for pipework at max. 95°C operating temperature and temperature maintenance for metal waste pipes with fatty waste water

FS-C-2X 31 W/m at 5°C

22 W/m at 40°C

2. Composition of the FS-A/B/C-2X heating cable



- 1 Copper conductor (1.2 mm²)
- 2 Self-regulating heating element
- 3 Modified polyolefin insulation (FS-C-2X: Fluoropolymer)
- 4 Protective tinned copper braid
- 5 Modified polyolefin protective jacket

3. Insulation selection

Frost protection down to -20°C.

Pipe diameter													
Insulation thicknesses	mm	15	22	28	35	42	54	67	76	108	125	150	200
	Inches	1/2"	3/4"	1"	5/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
10 mm		FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X				
15 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X			
20 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X		
25 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	
30 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X
40 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X	FS-B-2X
50 mm		FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-A-2X	FS-B-2X	FS-B-2X	FS-B-2X

Frost protection cables FS-A-2X and FS-B-2X are suitable for any pipe material (copper, threaded pipes, stainless steel pipes, plastic pipes and composite metal pipes without restriction).

For plastic pipes, please use aluminium adhesive tape ATE-180. The frost protection cable should be covered along its entire length. Heat insulation $\lambda = 0.035$ W/(m.K) or better.

Important note: frost protection heating cables with fluoropolymer protective jacket (e.g. type BTV2-CT) must be used for solvent-containing, mixed and/or bitumen-coated heat insulation.

40°C temperature maintenance on pipelines for fatty waste water

Pipe diameter (mm)									
Insulation thicknesses		42	54	67	76	108	125	150	200
		1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"
30 mm		FS-C-2X							
40 mm		FS-C-2X	FS-C-2X	FS-C-2X					
50 mm		FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X				
60 mm		FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X	FS-C-2X

Min. ambient temperature -10°C. Heat insulation $\lambda = 0.035$ W/(m.K) or better.

Cable type FS-C-2X should only be used for pipework with a minimum continuous temperature resistance of 90°C. A line-sensing control thermostat (type AT-TS-14 or RAYSTAT-CONTROL-10) must be used on plastic pipework (setting approx. 40°C).

Frost protection for pipes

4. Cable length

The heating cable should be installed in a straight line on the pipework. Cable loops instead of T-connections can be made on short stubs (up to approx. 3 m)

- + approx. 0.3 m per connection
 - + approx. 1.0 m per T-connection
 - + approx. 1.2 m per 4-way connection
- Additional cable required for increased heat sinks at valves from 2" and for uninsulated pipe supports (approx. 1 m)
-
- = required heating cable length

5. Electrical protection

- The total length of heating cable determines the number and size of the fuses
- Residual current device (rcd): 30 mA required, max. 500 m heating cable per rcd
- Installation according to local regulations
- The power connections must be carried out by an approved electrical installer
- Use C type circuit-breakers

Max. length of the heating circuit is based on a minimum switch-on temperature of 0°C, 230 VAC.

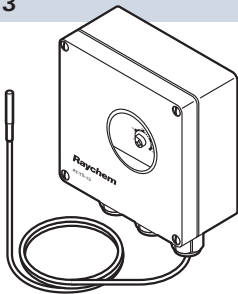
	FS-A-2X	FS-B-2X	FS-C-2X
4 A	45 m	25 m	20 m
6 A	70 m	35 m	30 m
10 A	110 m	65 m	55 m
13 A	130 m	85 m	70 m
16 A	150 m	105 m	90 m

6. Testing of the installation

See page 50

7. Thermostats

AT-TS-13

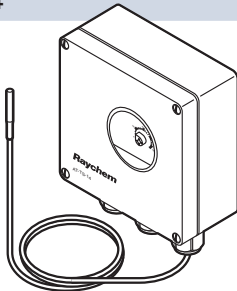


Thermostat

- Adjustable temperature range: -5°C to +15°C
- Line-sensing control thermostat or ambient thermostat
- Max. switching current 16 A, 250 VAC

Technical data: see page 26

AT-TS-14

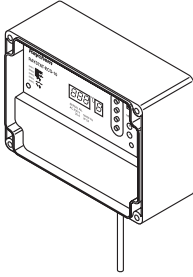


Thermostat

- Adjustable temperature range: 0°C to 120°C
- Temperature maintenance on pipelines for fatty waste water
- Line-sensing control thermostat
- Max. switching current 16 A, 250 VAC

Technical data: see page 26

RAYSTAT-ECO-10

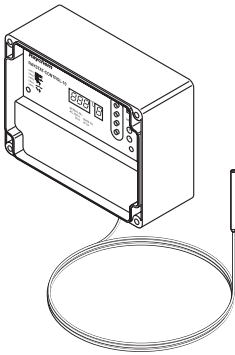


Ambient temperature thermostat

- Adjustable temperature range: 0°C to 30°C
- Max. switching current 25 A, 250 VAC
- PASC (Proportional Ambient Sensing Control) for energy saving
- Alarm relay: 2 A voltage free with indication of sensor errors, voltage errors and low or high temperature alarm
- Display for visual indication of parameters

Technical data: see page 28

RAYSTAT-CONTROL-10

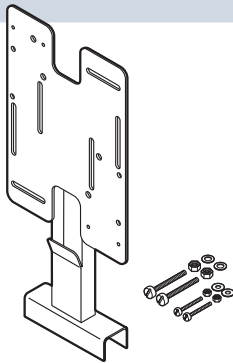


Line-sensing thermostat

- Adjustable temperature range: 0°C to 150°C
- Max. switching current 25 A, 250 VAC
- Alarm relay: 2 A voltage free with indication of sensor errors, voltage errors and low or high temperature alarm
- Display for visual indication of parameters

Technical data: see page 30

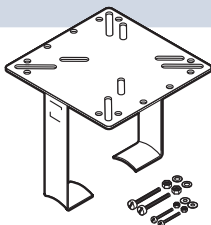
SB-100



Stainless steel support bracket

- Specially constructed to provide heating cable protection between pipe and junction box via a tubular leg.
- For use with AT-TS-13, AT-TS-14, JB 16-02 and RAYSTAT-CONTROL-10

SB-101

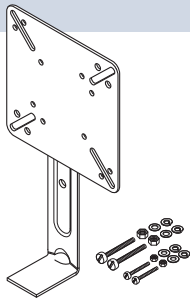


Dual-leg support bracket, stainless steel

- Height leg: 160 mm
- For use with AT-TS-13, AT-TS-14, JB 16-02 and RAYSTAT-CONTROL-10

Frost protection for pipes

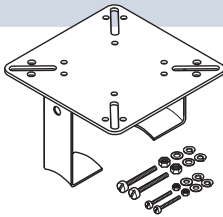
SB-110



Support bracket, stainless steel

- Height leg: 100 mm
- For use with AT-TS-13, AT-TS-14, and JB 16-02

SB-111



Support bracket, stainless steel

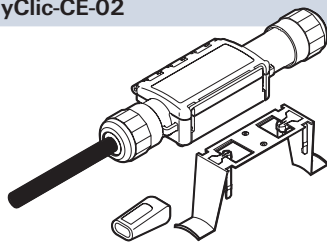
- Height leg: 100 mm
- For use with AT-TS-13, AT-TS-14, and JB 16-02

8. Accessories for FS-A-2X and FS-B-2X cables

	FS-A-2X FS-B-2X
Power connection	RayClic-CE-02
Splice	RayClic-S-02
Powered splice	RayClic-PS-02
T-connection	RayClic-T-02
Powered T-connection	RayClic-PT-02
Four way connection	RayClic-X-02

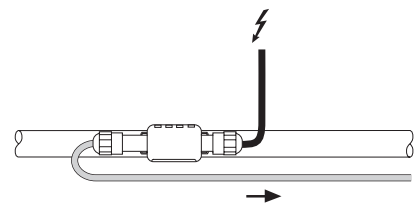
Note: A splice can also be made using an S-06.

RayClic-CE-02



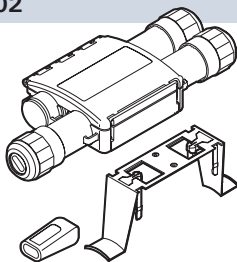
Power connection

- With 1.5 m power cable
- End seal and support bracket
- IP 68 moisture ingress protection
- External dimension: L = 240 mm
W = 64 mm
H = 47 mm



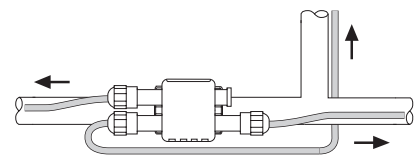
Note: RayClic components are not compatible with FS-C-2X

RayClic-T-02



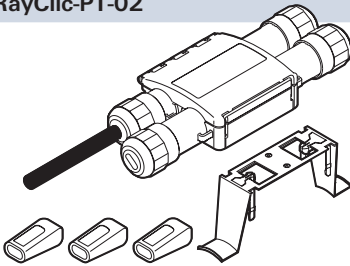
T-connection

- Connection for 3 cables
- End seal and support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 mm



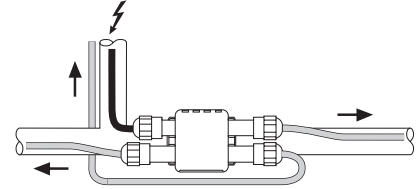
Note: RayClic components are not compatible with FS-C-2X

RayClic-PT-02



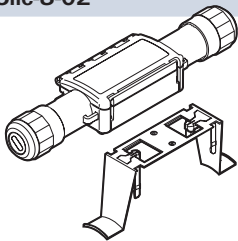
Power T-connection

- 3 connections with integral 1.5 m power cable
- 3 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42mm



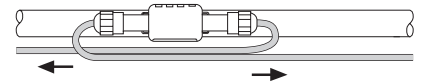
Note: RayClic components are not compatible with FS-C-2X

RayClic-S-02



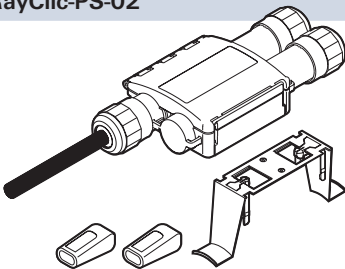
Splice for joining 2 lengths of heating cable

- Connection for 2 cables with 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 240 mm
W = 64 mm
H = 47 mm



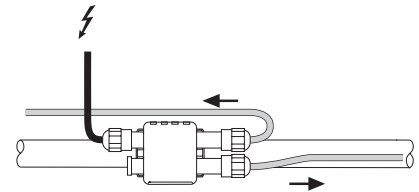
Note: RayClic components are not compatible with FS-C-2X

RayClic-PS-02



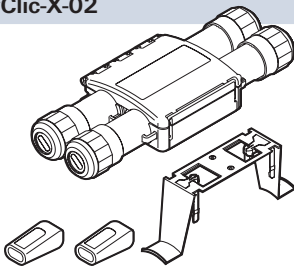
Powered splice

- Connection for 2 cables with integral 1.5 m power cable
- 2 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 mm



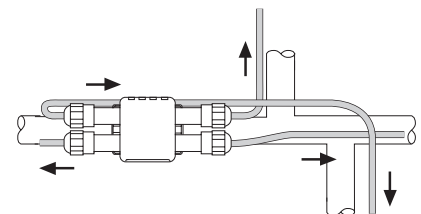
Note: RayClic components are not compatible with FS-C-2X

RayClic-X-02



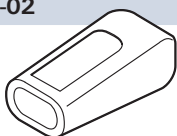
4-way connection

- Connection for 4 cables
- 2 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 mm



Note: RayClic components are not compatible with FS-C-2X

RayClic-E-02



Gel-filled end seal

- For system extensions (to be ordered separately)
- IP 68 weather protection



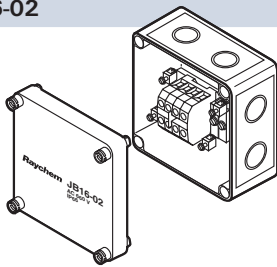
Note: RayClic components are not compatible with FS-C-2X

Frost protection for pipes

9. Accessories for FS-C-2X and BTV-2-CT cables

			For BTV-2-CT			For FS-C-2X			
Power connection	1 JB16-02	+	1 C25-21	+	1 E-06	+	1 CE20-01	+	JB-SB-08
Splice	1 JB16-02	+	2 C25-21	+	1 E-06	+	2 CE20-01	+	JB-SB-08
Powered splice	1 JB16-02	+	2 C25-21	+	2 E-06	+	2 CE20-01	+	JB-SB-08
T-connection	1 JB16-02	+	3 C25-21	+	2 E-06	+	3 CE20-01	+	JB-SB-08
Powered T-connection	1 JB16-02	+	3 C25-21	+	3 E-06	+	3 CE20-01	+	JB-SB-08
Four way connection	1 JB16-02	+	4 C25-21	+	3 E-06	+	4 CE20-01	+	JB-SB-08

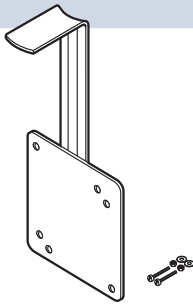
JB16-02



Temperature-resistant junction box

- For FS-C-2X and BTV-2-CT
- For power connection or T-connection
- IP66
- 6 x 4 mm² terminals
- 4 Pg 11/16, 4 M20/25 knock-out entries

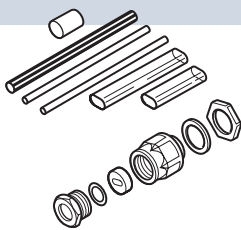
JB-SB-08



Single-leg support bracket (VA)

- for junction and connection box JB16-02

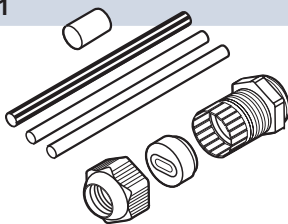
CE20-01



Connection and end seal kit for FS-C-2X cables

- Heat-shrink technique
- M20 gland

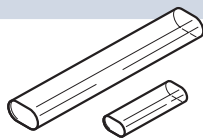
C25-21



Connection kit for BTV2-CT

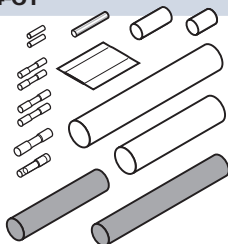
- Heat-shrink technique
- M25 gland

E-06



End seal kit for BTV2-CT

CCE-04-CT

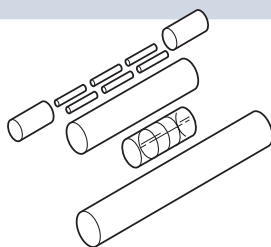


Cold lead connection and end seal kit

- Connection of 3 x 1.5 mm² or 3 x 2.5 mm² cold lead cable to self-regulating heating cables BTV-CT and FS-C.

10. General accessories

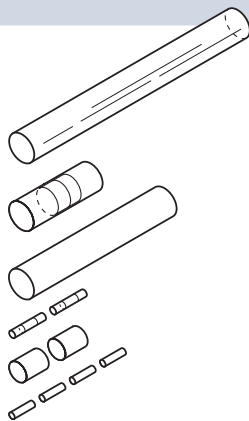
S-06



In-line splice kit

- for FS-A-2X and FS-B-2X

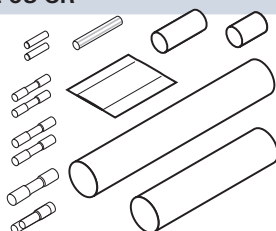
S-19



In-line splice kit

- for FS-C-2X and BTV-2-CT

CCE-03-CR

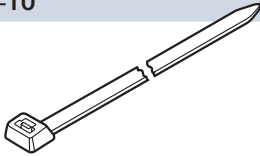


Cold lead connection and end seal kit

- Connection of 3 x 1.5 mm² or 3 x 2.5 mm² cold lead cable to self-regulating heating cables FS-A-2X and FS-B-2X

Frost protection for pipes

KBL-10



Cable ties

- One pack of 100 required for approx. 30 m of pipework
- Length: 370 mm
- Temperature and UV resistant

On plastic pipes use ATE-180 tape

GT-66



Heat-resistant glass cloth tape

- For steel pipes or for any installation below 4.4°C
- 20 m roll for approx. 20 m of pipework

On plastic pipes use ATE-180 tape

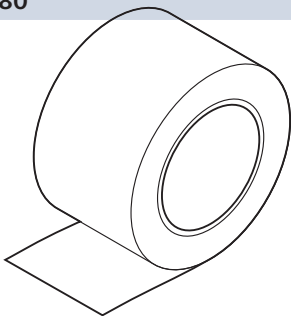
GS-54



Glass cloth tape for attaching heating cable to pipe

- For stainless-steel pipes or for any installation below 4.4°C
- 16 m per roll, 12 mm width

ATE-180

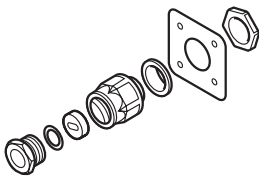


Aluminium adhesive tape

- Heat resistant
- 55 m roll for approx. 50 m of pipework

On plastic pipes: the heating cable must be covered with aluminium adhesive tape along its entire length

IEK-20-M



Insulation entry kit

- Insertion of heating cable in metal cladding
- Consists of: metal fastener, metric gland and joint seal

LAB-I-01



Electric traced label

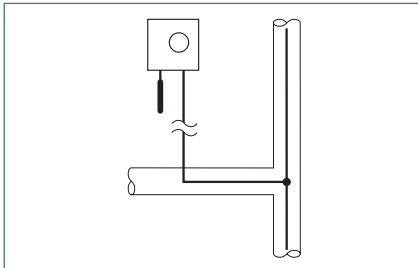
- To be placed at 5 m intervals on insulation surface

11. General installation instructions

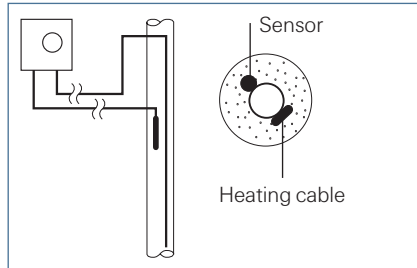
See page 32

12. Special installation instructions

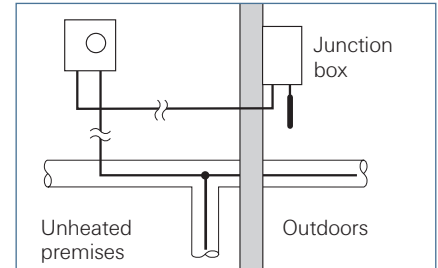
Placing of sensor



Ambient sensor



Fasten the pipe sensor to the pipe-work (e.g. aluminium adhesive tape)

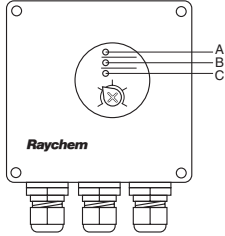


Always place the sensor in the coldest part of the installation

Frost protection for pipes

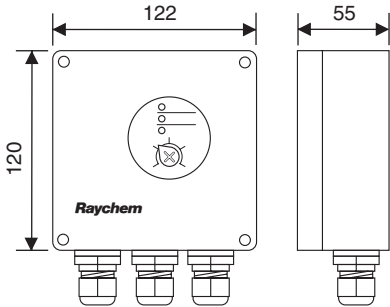
Line-sensing control and ambient thermostats (AT-TS-13 and AT-TS-14)

Unit layout



A Green LED	Heating cable on
B Red LED	Sensor break
C Red LED	Sensor short-circuit

Technical data



Supply voltage	230 VAC +10% – 15% 50/60 Hz
Power consumption	≤ 1.8 VA
Approval	CE
Max. switching current	16 A, 250 VAC
Max. conductor size	2.5 mm ²
Switching differential	0.6 to 1 K
Switching accuracy	AT-TS-13 ± 1 K at 5°C (calibration point)
	AT-TS-14 ± 2 K at 60°C (calibration point)
Switch type	SPST (normally open)
Adjustable temperature range	AT-TS-13 –5°C to +15°C
	AT-TS-14 0°C to +120°C

Housing

Temperature setting	inside
Exposure temperature	–20°C to +50°C
Ingress protection	IP65 according to EN 60529
Entries	1 x M20 for supply cable (∅ 8-13 mm) 1 x M25 for connection heating cable (∅ 11–17 mm) 1 x M16 for sensor
Weight (without sensor)	approx. 440 g
Material	ABS
Lid fixing	nickel-plated quick release screws
Mounting	On wall or on support bracket SB-110/SB-111

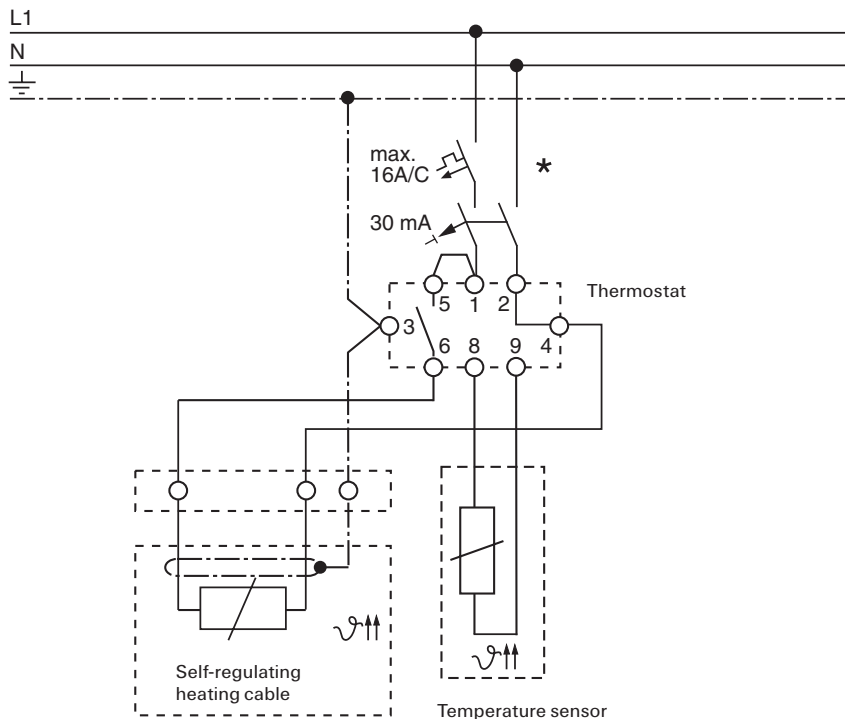
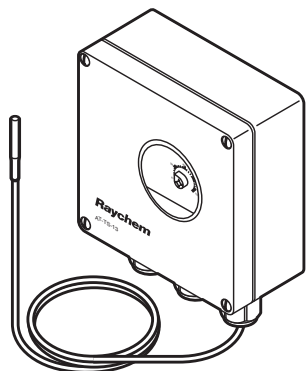
Temperature sensor (HARD-69)

Type	PTC KTY 83-110
Length sensor cable	3 m
Diameter sensor cable	5.5 mm
Diameter sensor head	6.5 mm
Max. exposure temperature sensor cable	160°C

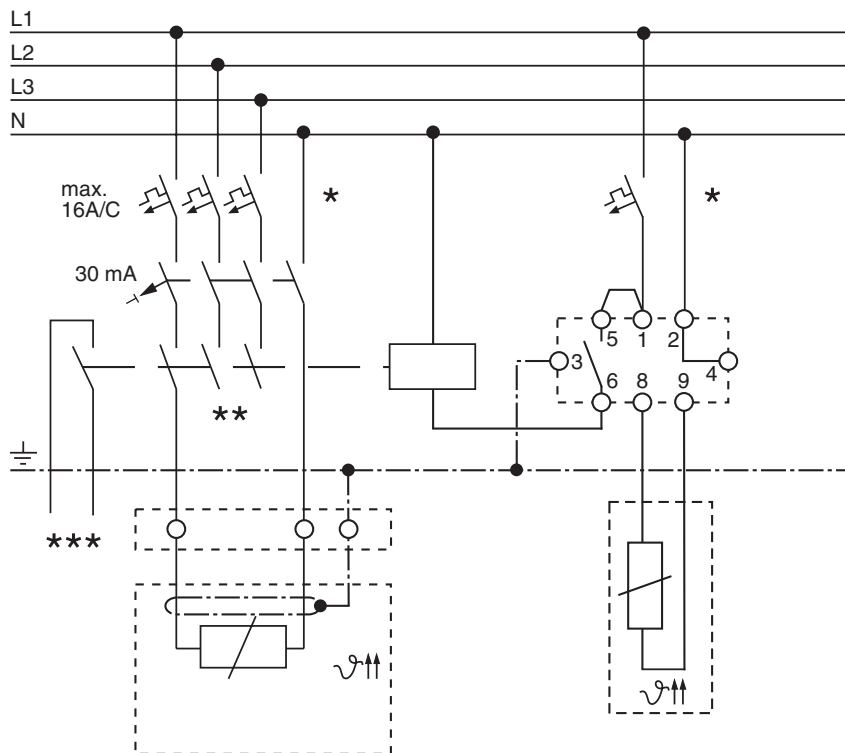
The sensor cable may be extended up to 100 m using a cable with a cross-section of 1.5 mm².
The sensor cable should be shielded if it is laid in cable ducts or in the vicinity of high-voltage cables.

Wiring diagram for thermostat AT-TS-13 or AT-TS-14

AT-TS-13/14 direct



AT-TS-13/14 with contactor

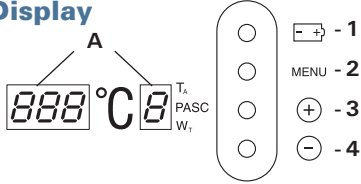


- * Two- or four-pole electrical protection by circuit-breaker may be needed for local circumstances, standards and regulations
- ** Depending on the application, one- or three-pole circuit-breakers or contactors may be used
- *** **Optional:** Potential-free circuit-breaker for connection to the BMS

Frost protection for pipes

Energy saving frost protection controller RAYSTAT-ECO-10

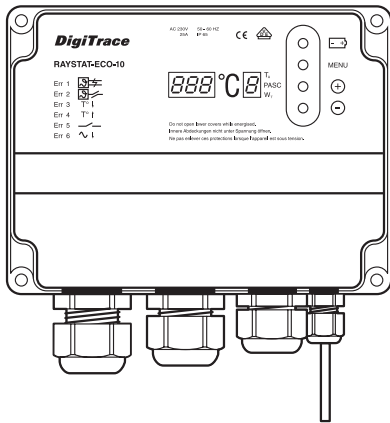
Display



A. LED Display (parameter and error indications)

1. Battery activation
2. Parameter menu selection
3. Increase value
4. Decrease value

Technical data



Operating Voltage	230 VAC, +10%/−10%, 50/60 Hz
Power Consumption	≤ 14 VA
Main Relay (heating)	I _{max} 25 A, 250 VAC, SPST
Main Terminals	3 x 0.75 mm ² to 4 mm ²
Alarm Relay	I _{max} 2 A, 250 VAC, SPDT, voltfree
Alarm Terminals	(3 + ±) x 0.75 mm ² to 2.5 mm ²
Accuracy	±0.5 K at 5 °C

Main parameter settings

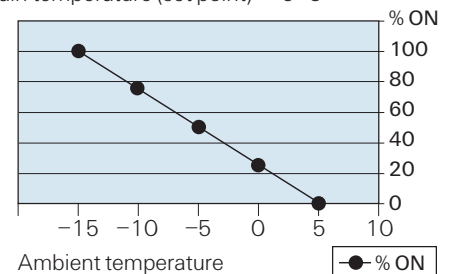
Energy Saving Algorithm	Proportional Ambient Sensing Control (PASC) active below setpoint
Temperature Setpoint	0 °C to +30 °C (switch off temperature)
Minimum Expected Ambient Temperature	−30 °C to 0 °C (heating 100% powered)
Heater Operation if Sensor Error	ON (100%) or OFF
Voltage Free Operation	YES or NO

Energy saving with Proportional Ambient Sensing Control (PASC)

Duty cycle (power to heater on) depends on the ambient temperature. For example: If minimum temperature = −15 °C and if maintain temperature (set point) = +5 °C

ambient t°	% ON	
−15	100	Min. Ambient
−10	75	
−5	50	
0	25	
5	0	Set point

Result: At ambient temperature of −5 °C, 50% energy is saved



Diagnosed alarms

Sensor Errors	Sensor short / Sensor open circuit
Low Temperature	Min. expected ambient temperature reached
Voltage Errors	Low supply voltage / Output voltage / fault

Parameters can be programmed without power supply and parameters are stored in non-volatile memory.

Housing

Size	120 mm x 160 mm x 90 mm
Material	Grey polycarbonate
Exposure Temperature Range	−40 °C to +80 °C
Ingress Protection	IP 65
Entries	2 x M25, 1 x M20, 1 x M16
Weight	Approx. 800 g
Lid	Transparent with 4 captive screws
Mounting	On wall or on support bracket SB-100/SB-101

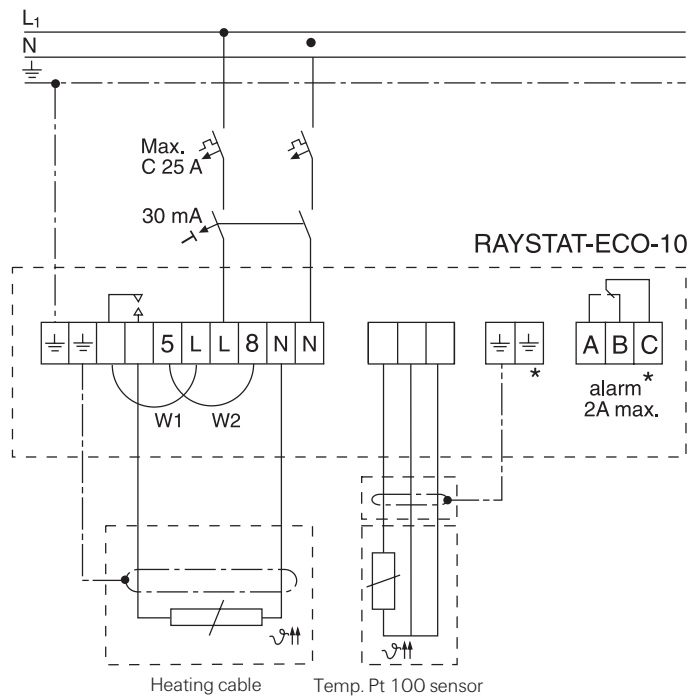
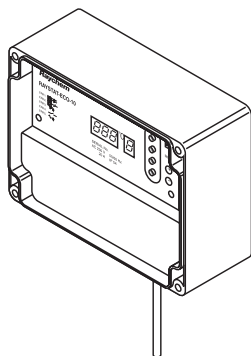
Temperature sensor

Sensor Type	3-wire Pt100 according to IEC Class B
Sensor Head	6 mm

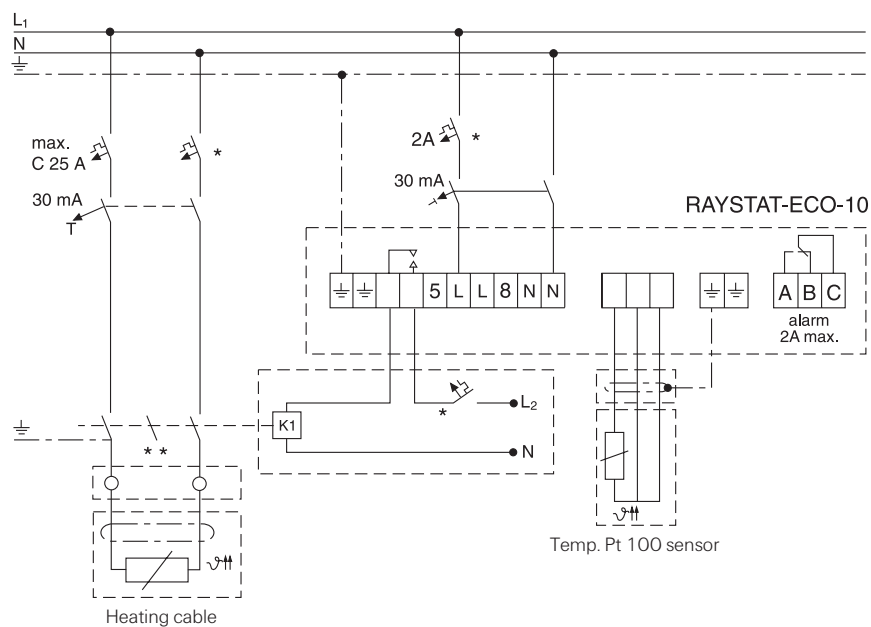
Sensor cable can be extended up to 150 m when a cross-section of 3 x 1.5 mm² is used. The sensor cable should be shielded if it is laid in cable ducts or in the vicinity of high-voltage cables.

Wiring diagram for RAYSTAT-ECO-10

Normal operation



Voltage Free operation: Remove links W1 and W2



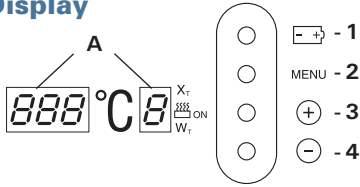
* Electrical protection by circuit breaker may be needed for local circumstances, standards and regulations.

** Depending on the application, one or three-pole circuit breakers or contactors may be used.

Frost protection for pipes

Line-sensing thermostat with alarm relay RAYSTAT-CONTROL-10

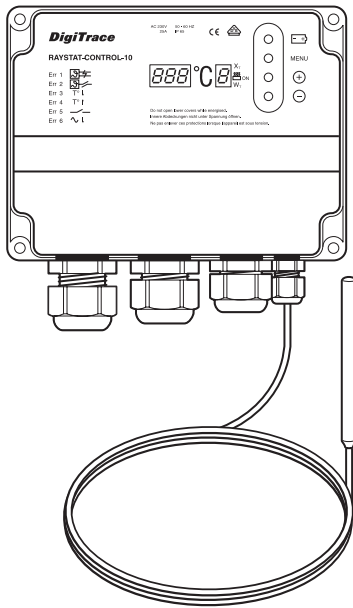
Display



A. LED Display (parameter and error indications)

1. Battery activation
2. Parameter menu selection
3. Increase value
4. Decrease value

Technical data



Operating Voltage	230 VAC, +10%/−10%, 50/60 Hz
Power Consumption	≤ 14 VA
Main Relay (heating)	I _{max} 25 A, 250 VAC, SPST
Main Terminals	3 x 0.75 mm ² to 4 mm ²
Alarm Relay	I _{max} 2 A, 250 VAC, SPDT, voltfree
Alarm Terminals	(3 + $\frac{+}{-}$) x 0.75 mm ² to 2.5 mm ²
Accuracy	±0.5 K at 5 °C
Ambient temperature	−40 °C to +40 °C

Parameter settings

Temperature Setting	0 °C to +150 °C
Hysteresis	1 K to 5 K
Low Temperature Alarm	−40 °C to +148 °C
High Temperature Alarm	+2 °C to +150 °C or switched OFF
Heater Operation if Sensor Error	ON or OFF
Voltage Free Operation	YES or NO

Diagnosed errors

Sensor Errors	Sensor short / Sensor open circuit
Temperature Extremes	High temperature / Low temperature
Voltage Errors	Low supply voltage / Output fault

Parameters can be programmed without power supply and parameters are stored in non-volatile memory.

Housing

Size	120 mm x 160 mm x 90 mm
Material	Grey polycarbonate
Ingress Protection	IP 65
Entries	2 x M25, 1 x M20, 1 x M16
Weight	Approx. 800 g
Lid	Transparent with 4 captive screws
Mounting	On wall or on support bracket SB-100/SB-101

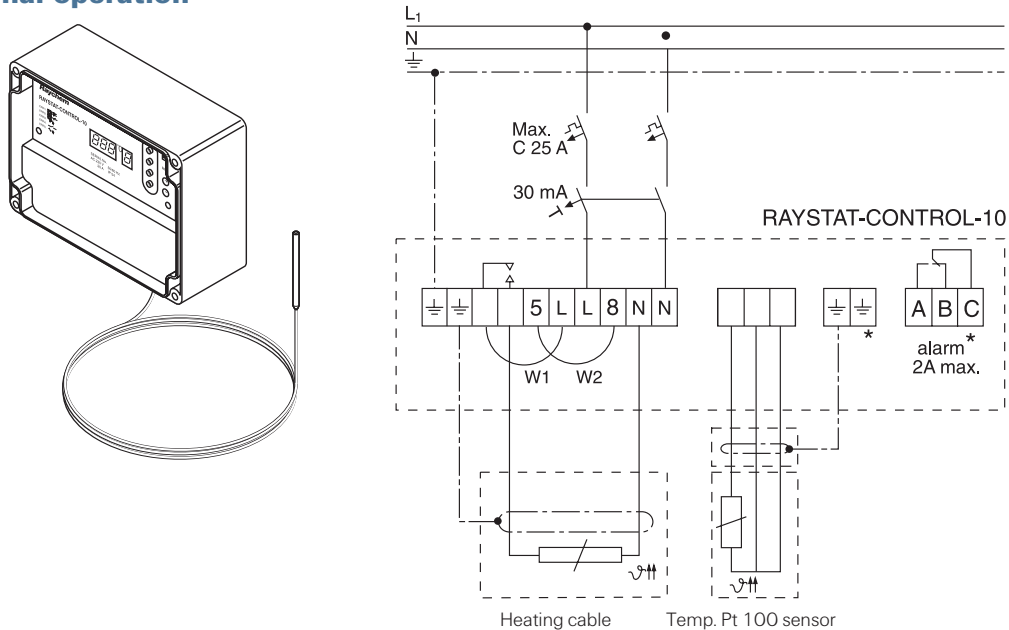
Temperature sensor

Sensor Type	3-wire Pt100 according to IEC / Class B
Sensor Head	50 mm x Ø 6 mm
Sensor Cable Length	3 m x Ø 4 mm
Cable Exposure Temperature	−40 °C to +150 °C (+215 °C, 1000 h max.)

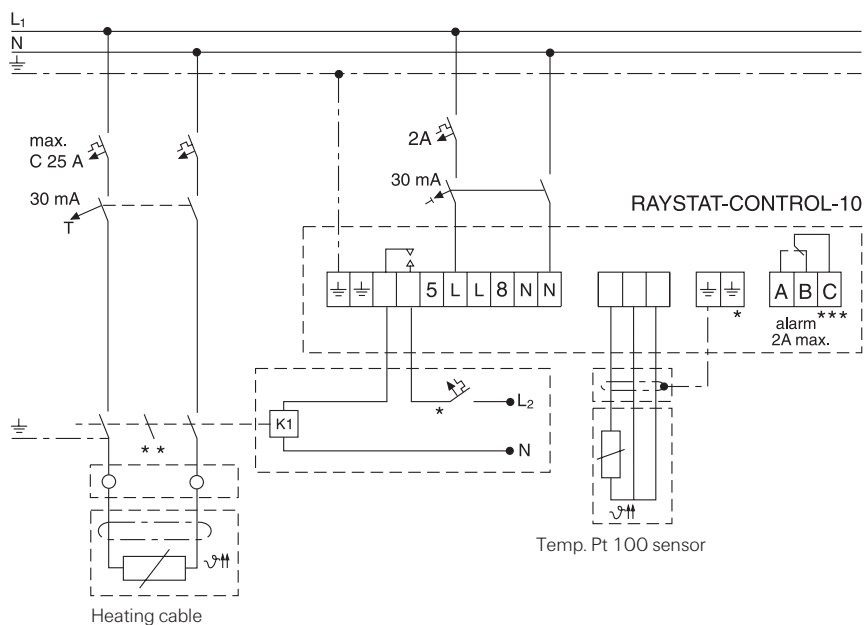
Sensor cable can be extended up to 150 m when a cross-section of 3 x 1.5 mm² is used. The sensor cable should be shielded if it is laid in cable ducts or in the vicinity of high-voltage cables.

Wiring diagram for RAYSTAT-CONTROL-10

Normal operation



Voltage Free operation: Remove links W1 and W2

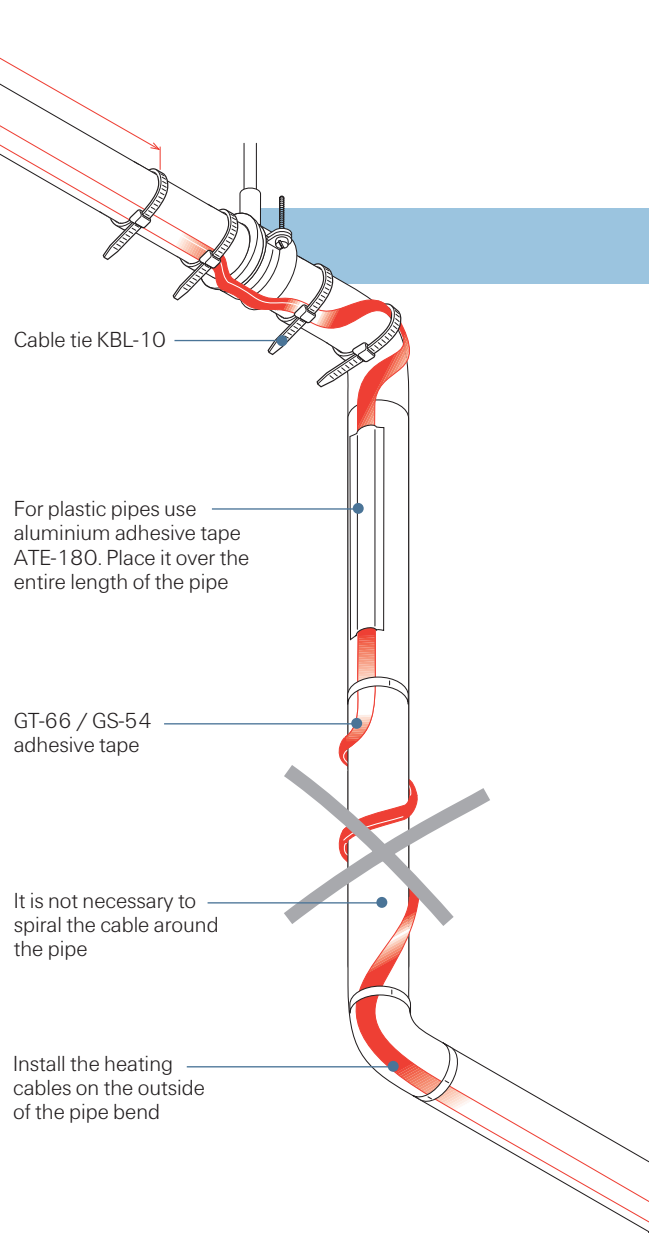
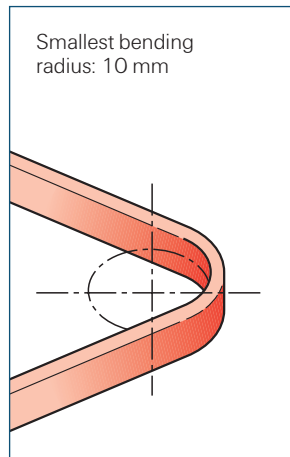
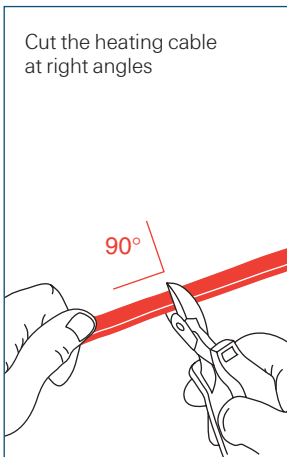
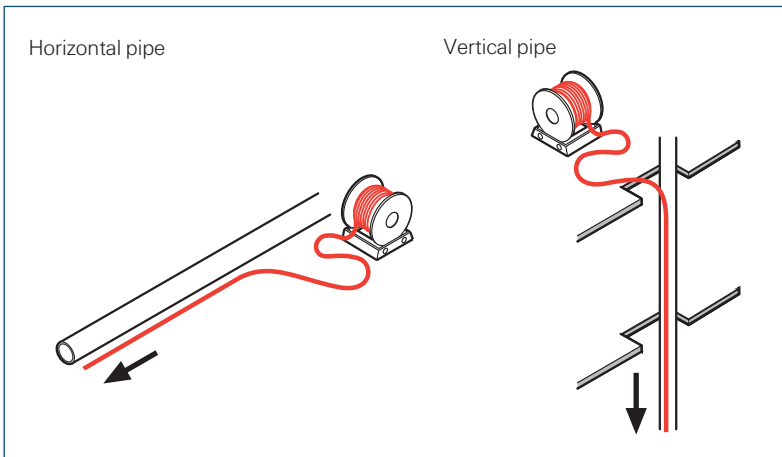
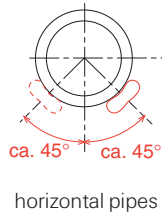


- * Electrical protection by circuit breaker may be needed for local circumstances, standards and regulations
- ** Depending on the application, one or three-pole circuit breakers or contactors may be used
- *** Optional

Frost protection for pipes

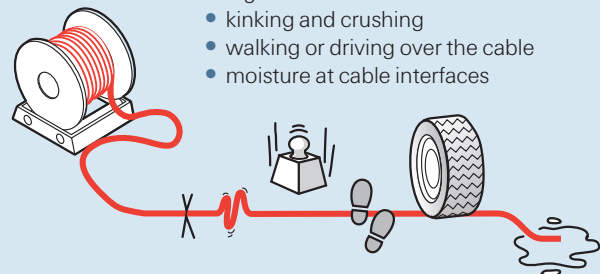
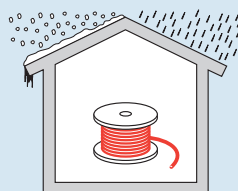
11. Installation instructions for FS-A/B/C-2X cables

- The heating cable should be installed in a straight line on the pipework.
- Install on dry surfaces
- Minimum installation temperature: -10°C



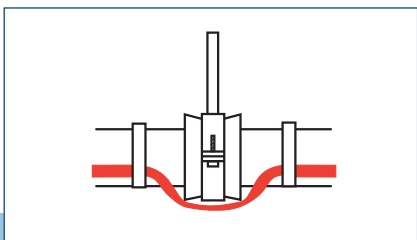
Installation of self-regulating heating cables

- Store in a dry and clean place.
- Temperature range: -40°C to $+60^{\circ}\text{C}$.
- Protect any cable ends with an end seal.

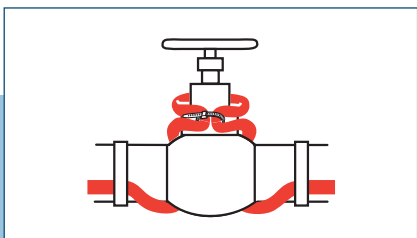
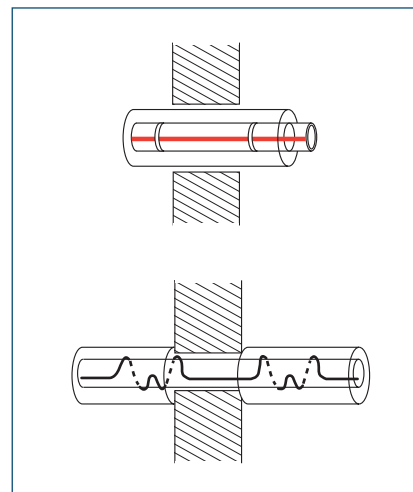
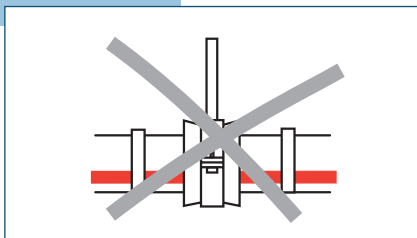


Avoid:

- sharp edges
- high tractive force
- kinking and crushing
- walking or driving over the cable
- moisture at cable interfaces



- Run the cable over pipe suspensions
- Do not clamp the cable

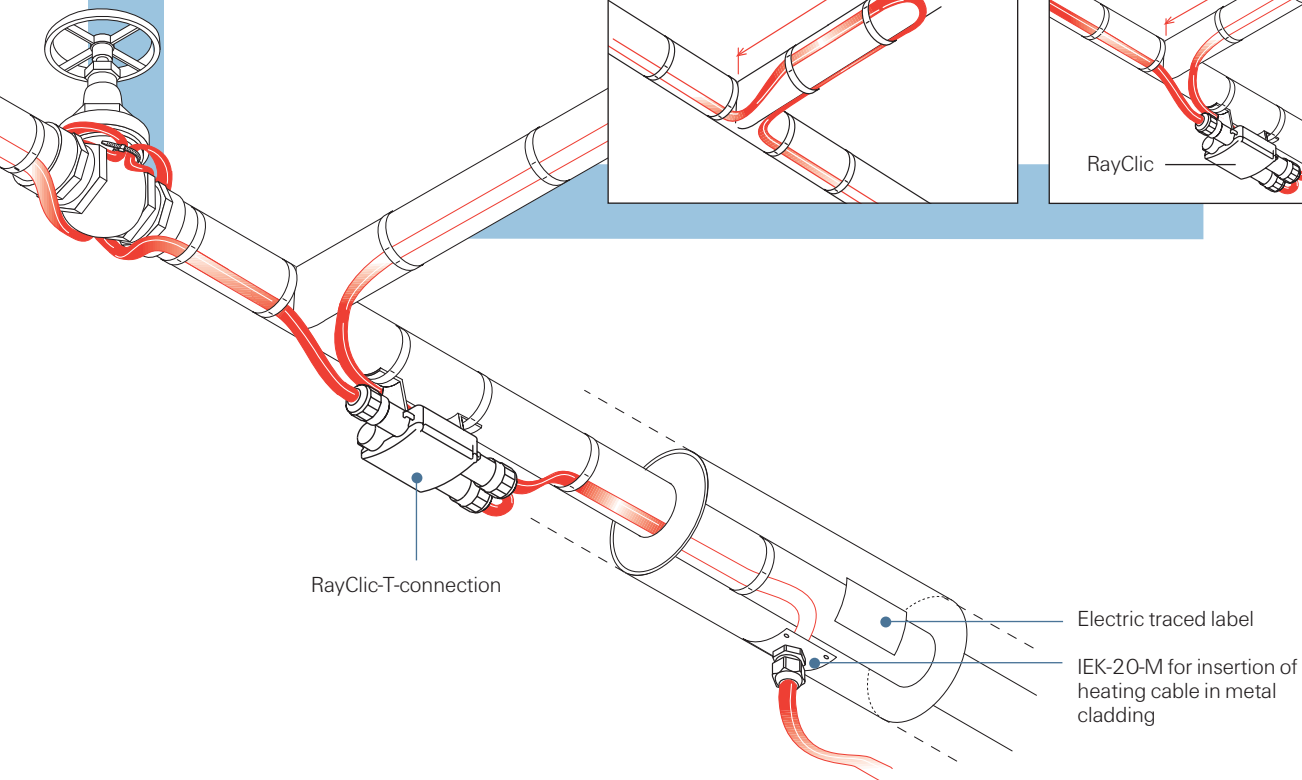
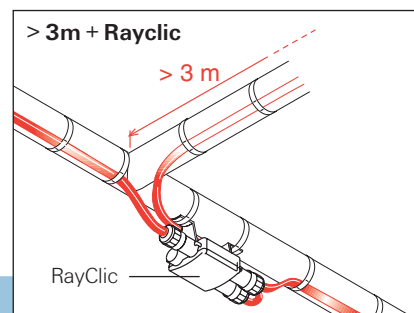
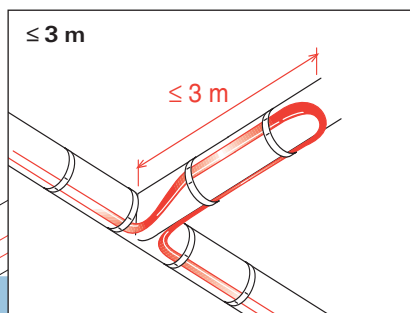
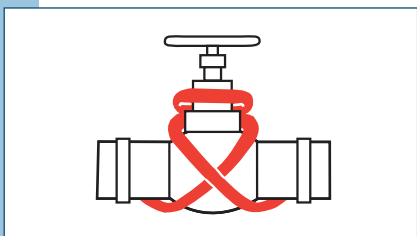


Frost protection at valves:

- Valves up to 2" (DN 50): install the frost protection heating cables in a straight line
- $\geq 2"$: lay as shown
- Always insulate valves

Wall/Floor transit

The thickness of thermal insulation must be continuous otherwise compensate by adding heating cable.



General installation instructions

Checklist for problem-free installation and safe operation

Typical installation schedule for hot water temperature maintenance

General order of events

- The system is designed and the installation planned
- The pipework is pressure tested or otherwise checked for leaks
- The HWAT-L/M/R cable is tested and then installed on the designated pipes
- The components are installed and each circuit is tested
- The correct thermal insulation is applied, without delay, labelled and the system test repeated
- The supply voltage cables and circuit breakers are installed to each circuit
- The system is commissioned (see "System start-up" below)

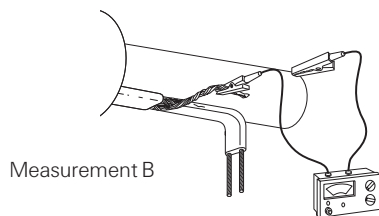
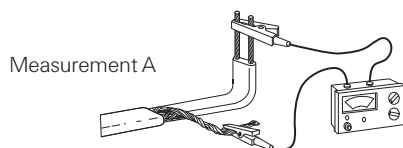
Circuit protection, testing and operation for all systems

Circuit protection

- Supply voltage 230 VAC, 50 Hz
- The required protective measures of the relevant regulations must be complied with.
- C type circuit breaker (anti-surge fuse)
- Residual current device (rcd 30 mA) required. Maximum approx. 500 m of self-regulating heating cable can be monitored per rcd

Testing

- Visual inspection for damage and fault-free installation of the accessories
- Proper installation of the system
- Heating cable affixed to all necessary pipes
- No mechanical damage to heating cable (e.g. cuts, cracks, etc.)
- No thermal damage
- Proper connection of all components including power supplies
- Insulation resistance measurement when heating cable is received and before and after installation of the thermal insulation. The test voltage should be 2500 VAC, but it must not be lower than 500 VAC. The insulation resistance, irrespective of the cable length, must not be less than 100 Mohms.
If the resistance falls below this value, the source of the fault must be investigated, eliminated, and re-tested.
 - Measurement A: Phase and neutral to the braid
 - Measurement B: Braid to the pipework
- After switching on, the cable ends must be warm after 5 to 10 minutes



Instructions for the placing of the heat insulation

- For problem-free operation of the self-regulating heating cables, the material quality and thickness of the thermal insulation should be in accordance with the design parameters, and this insulation must be installed correctly
- All parts of the pipework, including valves, wall transit points, etc. must be fully insulated

Operation / System start-up

- 1) For small installations, turn on the circuit breakers and preferably leave the system overnight for the water to warm up and stabilise
- 2) For bigger installations or for a faster start-up, first turn on the main water heater and open the outlet/tap at the end of the pipework run until the water feels warm and then turn on the circuit breakers
If the piping system is closed, such as by pressure-reducing valves or isolation valves, you must provide some method of pressure relief to allow for thermal expansion of the water during heat-up
- Under normal operating conditions, the heating cables are maintenance-free. Tyco Thermal Controls recommend that the insulation resistance should be checked periodically and compared with the original values. If the reading falls below the minimum value (100 Mohms) determine the cause and rectify before re-use
- The specified maximum ambient and operating temperatures should not be exceeded
- In the event of repair to the pipework, the heating cable must be protected against damage. Correct function of the electrical protection system should be maintained. To prevent shock or personal injury, turn off the power at the circuit breaker before testing or working on the heating cable or piping

- Following the completion of the repair work, the circuit should once again be tested (see above)
- All the important parts of the controls, thermostats, etc. must be checked for correct operation once a year, normally in the autumn

Only for hot water temperature maintenance

Newly installed heating cables have lower power at start-up of the installation. The nominal power will be reached after approximately 4 weeks of continuous operation

- The maintenance temperature should be 5°C to 10°C below the hot water temperature in the boiler

Standard assembly times

The actual assembly times achieved may deviate according to the conditions on site.

Pipework

Assembly of heating cable on pipes including fastening,
standard installation: 25 m/hour

Connection system

(electrical connection)

RayClic-CE-02	2 min/pc.
RayClic-S-02/RayClic-PS-02	4 min/pc.
RayClic-T-02/RayClic-PT-02	6 min/pc.
RayClic-X-02	8 min/pc.
RayClic-E-02	1 min/pc.

Heat-shrink connection system

(electrical connection)

C25-21	15 min/pc.
E-06	5 min/pc.
CE20-01	20 min/pc.

Other

Testing, visual inspection, insulation resistance measurement (2x)	10 min/heating circuit
Connecting the heating circuit in the switch box	10 min/heating circuit

General installation instructions

Trouble shooting guide

Fault	Possible causes	Measures
Circuit-breaker trips:	Circuit breaker wrong type: e.g. type B instead of C:	Change to C Type
	Circuit breaker undersized	If the power supply cable permits, install a larger circuit breaker
	Circuit too long	Split the circuit on 2 circuit breakers
	Short-circuit/earth fault	Eliminate short-circuit/earth fault (cable ends should not be twisted)
	Circuit breaker faulty	Replace faulty circuit breaker
	No end seal	Install end seal
	Conductor (or cable) twisted	Untwist and install end seal
	RCD residual current device trips:	More than 500 m of frost protection heating cable installed per rcd
Earth fault at connection or in end seal		Rectify earth fault
Cable damaged		Repair cable where damaged
Moisture in the junction box		Eliminate moisture
Pipeline does not become warm - Heating cable cold:	Circuit-breaker has tripped	See section circuit breaker
	Residual current device has tripped	See section residual current device
	No mains voltage	Switch on
	Cable or cold lead not connected	Connect cable or cold lead
	Cable not inserted correctly in connection system or end seal	Insert cable according to installation instructions (fully insert cable)
Water temperature is not maintained but the cable gives high output:	No insulation	Insulation according to tables in design guides
	Insulation thickness insufficient	Insulation according to tables in design guides
	Insulation wet	Dry insulation
	Cold water is running from the boiler	Test boiler temperature
	Cold water is pumping through mixer tap into the hot water pipe.	Test the mixer tap
	Insulation according to tables in design guides.	

