

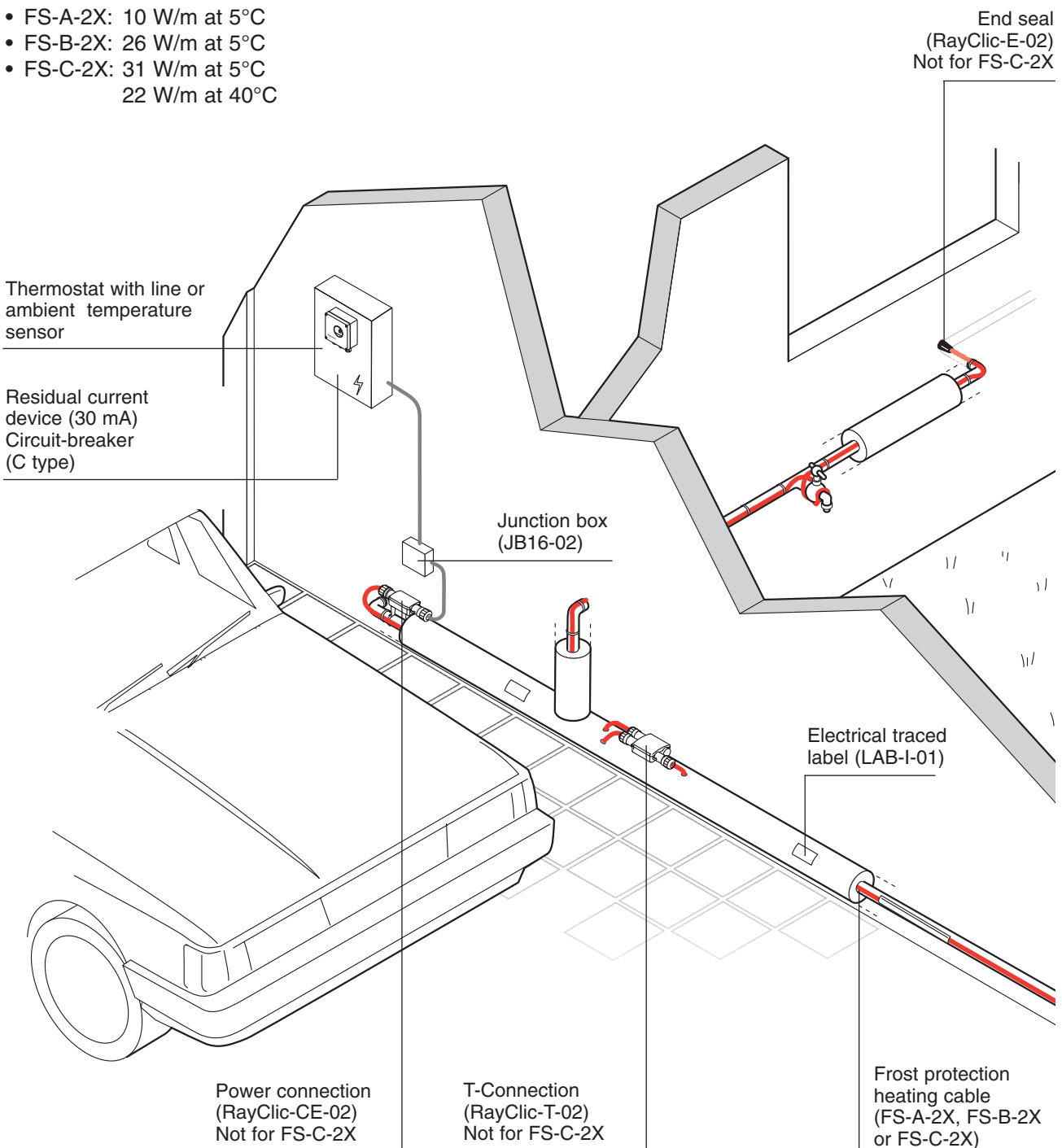
Raychem

Self-regulating frost protection system for pipes

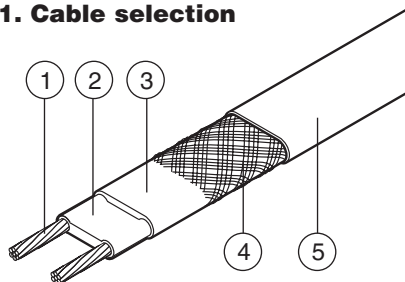
- Reliability: protects your pipes from frost damage
- Maintenance-free

Efficient energy use

- FS-A-2X: 10 W/m at 5°C
- FS-B-2X: 26 W/m at 5°C
- FS-C-2X: 31 W/m at 5°C
22 W/m at 40°C



1. Cable selection



Composition

1. Copper conductor (1.2 m²)
2. Self-regulating heat element
3. Insulation made of modified polyolefin (FS-C-2X: Fluoropolymer)
4. Protective tinned copper braid
5. Protective jacket made of modified polyolefin

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

Insulation selection

Frost protection up to -20°C.

Insulation thicknesses	Pipe diameter											
	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	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	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	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 $\lambda = 0.035 \text{ W/(m.K)}$ 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

Insulation thicknesses	Pipe diameter (mm)							
	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 $\lambda = 0.035 \text{ W/(m.K)}$ 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).

2. 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 amount required for increased heat sinks at valves from 2" and for uninsulated pipe supports (approx. 1 m)

= required heating cable length

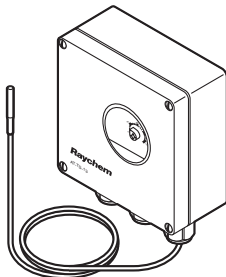
3. Electrical protection

- 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

4. Thermostats

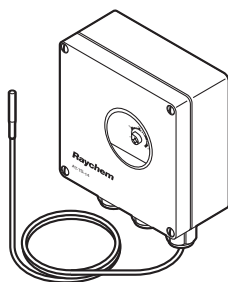


AT-TS-13

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 18

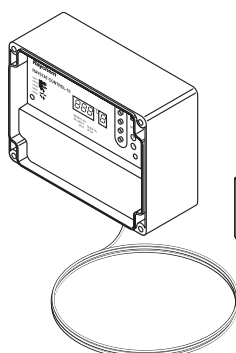


AT-TS-14

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 18

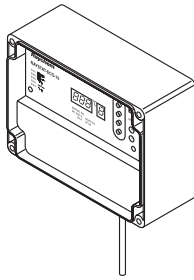


RAYSTAT-CONTROL-10

Line-sensing thermostat

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

Technical data: see page 19

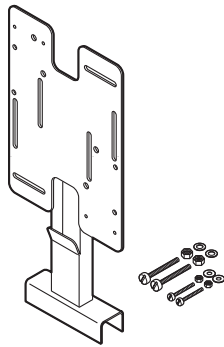


RAYSTAT-ECO-10

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 voltfree with indication of sensor errors, voltage errors and low or high temperature alarm
- Display for visual indication of parameters

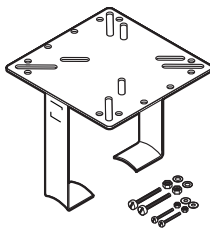
Technical data: see page 20



SB-100

Stainless steel support bracket specially constructed to provide heating cable protection between pipe and junction box via a tubular leg.

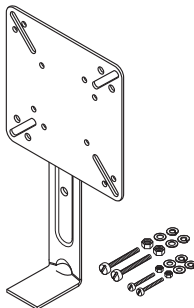
- For use with AT-TS-13, AT-TS-14, JB16-02 and RAYSTAT-CONTROL-10



SB-101

Dual-leg support bracket, stainless steel

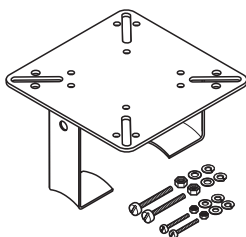
- Height leg: 160 mm
- For use with AT-TS-13, AT-TS-14, JB16-02 and RAYSTAT-CONTROL-10



SB-110

Support bracket, stainless steel

- Height leg: 100 mm
- For use with AT-TS-13, AT-TS-14, and JB16-02



SB-111

Support bracket, stainless steel

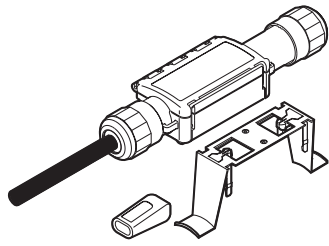
- Height leg: 100 mm
- For use with AT-TS-13, AT-TS-14, and JB16-02

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

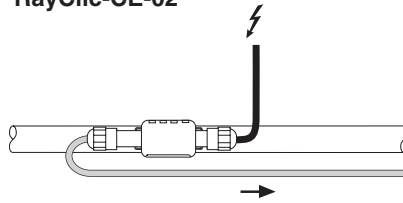
FS-A-2X FS-B-2X

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 one S-06.



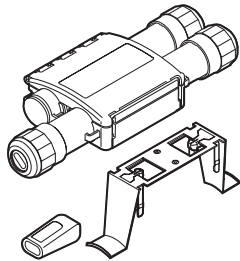
RayClic-CE-02



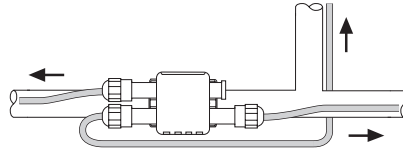
Power connection with 1.5 m power cable

- End seal and support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables



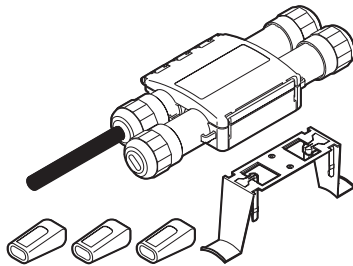
RayClic-T-02



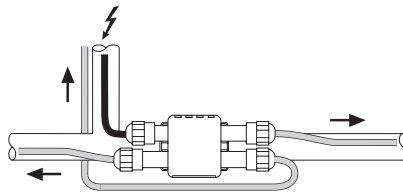
T-connection

- Connection for 3 cables
- End seal and support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables



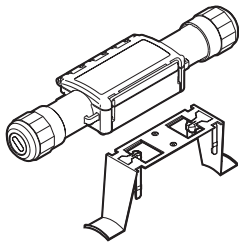
RayClic-PT-02



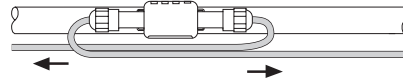
Power T-connection

- 3 connections with integral 1.5 m power cable
- 3 end seals and 1 support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables



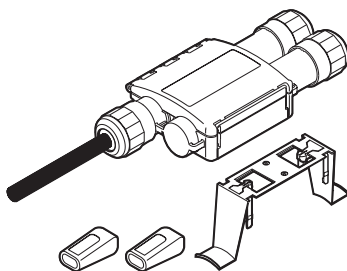
RayClic-S-02



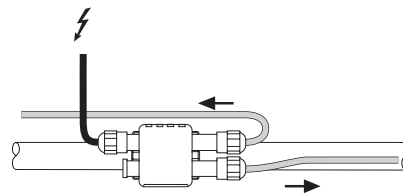
Splice for joining 2 lengths of heating cable

- Connection for 2 cables with 1 support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables



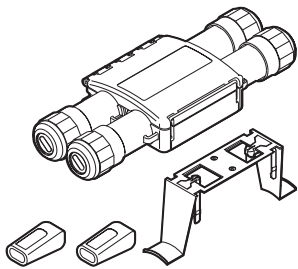
RayClic-PS-02



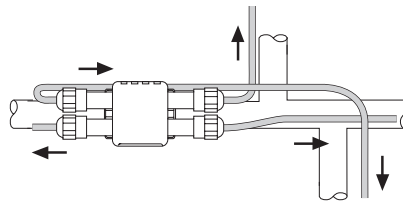
Powered splice

- Connection for 2 cables with integral 1.5 m power cable
- 2 end seals and 1 support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables

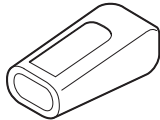


RayClic-X-02

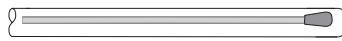


- 4-way connection
- Connection for 4 cables
- 2 end seals and 1 support bracket
- IP 68 weather protection

Cannot be used with FS-C-2X cables



RayClic-E-02

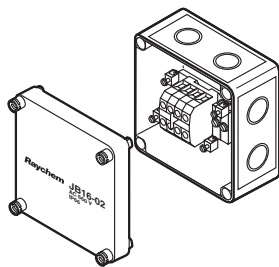


- Gel-filled end seal
- For system extensions (to be ordered separately)
- IP 68 weather protection

Cannot be used with FS-C-2X cables

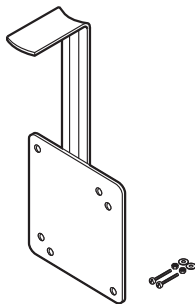
6. Accessories for FS-C-2X and BTV-2-CT cables

	For BTV-2-CT	For FS-C-2X
Power connection	1 JB16-02 + 1 C16-29 + 1 E-06 + 1 CE16-05 + 1 JB-SB-08	1 JB16-02 + 1 C16-29 + 1 E-06 + 1 CE16-05 + 1 JB-SB-08
Splice	1 JB16-02 + 2 C16-29 + 1 E-06 + 2 CE16-05 + 1 JB-SB-08	1 JB16-02 + 2 C16-29 + 1 E-06 + 2 CE16-05 + 1 JB-SB-08
Powered splice	1 JB16-02 + 2 C16-29 + 2 E-06 + 2 CE16-05 + 1 JB-SB-08	1 JB16-02 + 2 C16-29 + 2 E-06 + 2 CE16-05 + 1 JB-SB-08
T-connection	1 JB16-02 + 3 C16-29 + 2 E-06 + 3 CE16-05 + 1 JB-SB-08	1 JB16-02 + 3 C16-29 + 2 E-06 + 3 CE16-05 + 1 JB-SB-08
Powered T-connection	1 JB16-02 + 3 C16-29 + 3 E-06 + 3 CE16-05 + 1 JB-SB-08	1 JB16-02 + 3 C16-29 + 3 E-06 + 3 CE16-05 + 1 JB-SB-08
Four way connection	1 JB16-02 + 4 C16-29 + 3 E-06 + 4 CE16-05 + 1 JB-SB-08	1 JB16-02 + 4 C16-29 + 3 E-06 + 4 CE16-05 + 1 JB-SB-08



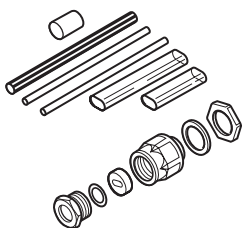
JB16-02

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



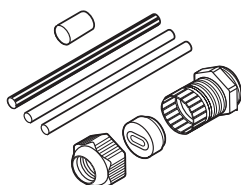
JB-SB-08

- Single-leg support bracket (VA) for junction and connection box JB16-02



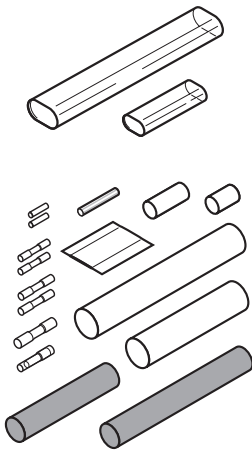
CE20-01

- Connection and end seal kit for FS-C-2X cables
- Heat-shrink technique
- M20 gland



C16-29

- Connection kit for BTV2-CT
- Heat-shrink technique
- Pg 16 gland



E-06

End seal kit for BTV2-CT

CCE-04-CT

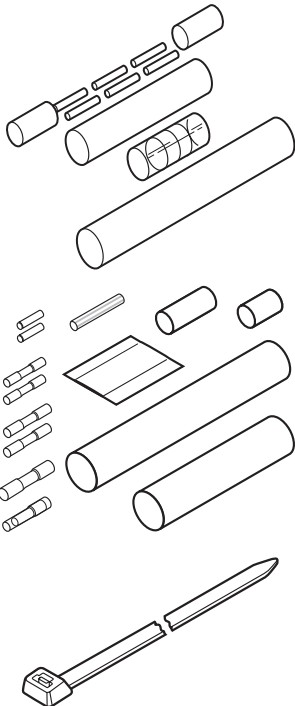
Cold lead connection and end seal kit

- 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.

7. General accessories

S-06

In-line splice kit for FS-A-2X, FS-B-2X



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, FS-B, HWAT-L/R/M, GM-2X

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

- Heat resistant up to 130°C
- 20 m roll for approx. 20 m of pipework

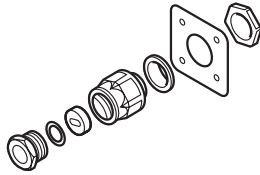
On plastic pipes use ATE-180 tape

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-16-05

Insulation entry kit

- Insertion of heating cable in metal cladding
- Consists of: metal fastener, Pg 16 gland and joint seal

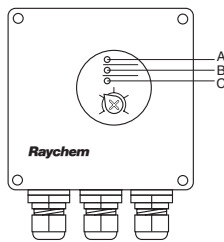
LAB-I-01

Electric traced label

- To be placed at 5 m intervals on pipework surface

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

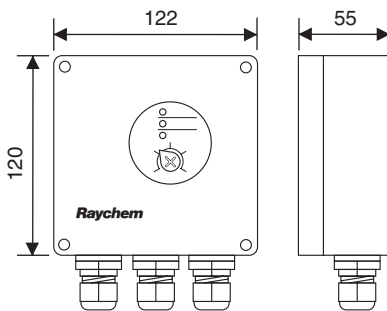
Unit layout



(Dimensions in mm)

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

Technical data



(Dimensions in mm)

Supply voltage	230 VAC +10% -15% 50/60 Hz
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 (Ø 8-13 mm) 1 x M25 for connection heating cable (Ø 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)

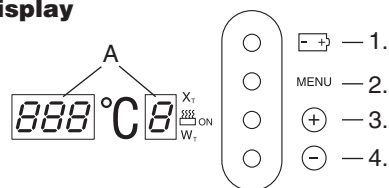
Type	PTC KTY 83-110
Length sensor cable	3 m
Diameter sensor cable	5.5 mm
Diameter sensor head	6.5 mm
Max. exposure temperature sensor cable	160°C

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.

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

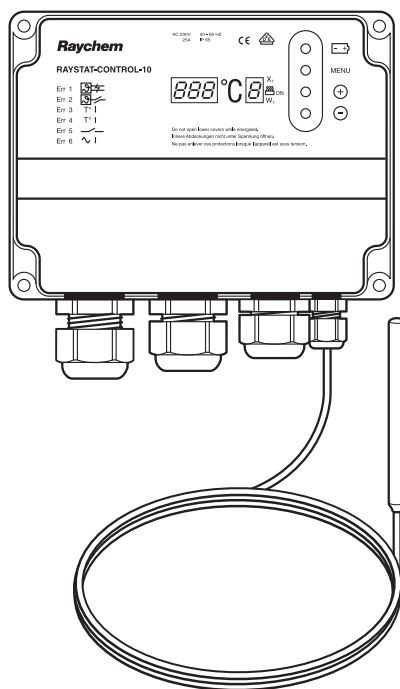
Display



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 ± ½) 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

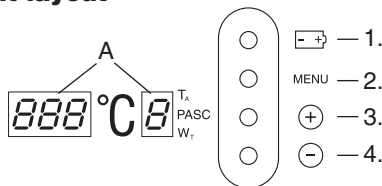
Size	120 mm x 160 mm x 90 mm
Material	Grey polycarbonate
Ingress Protection	IP 65
Entries	2 x M25, 1 x M20, 1 x M16
Weight	Approx. 800 g
Lid	Transparent with 4 captive screws
Mounting	On wall or on support bracket SB-100/SB-101

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.

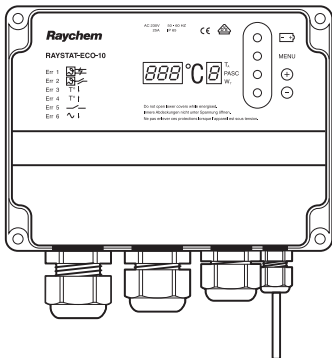
Unit layout



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	–40°C to –10°C (heating 100% powered)
Heater Operation if Sensor Error	ON (100%) or OFF
Voltage Free Operation	YES or NO

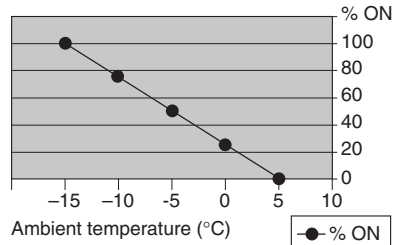
Energy saving with Proportional Ambient Sensing Control (PASC)

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
–10	75
–5	50
0	25
5	0

Min. Ambient
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	–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.