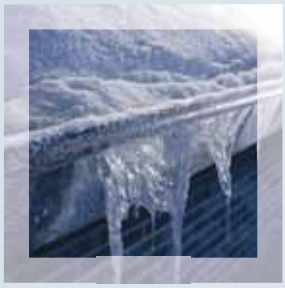
Raychem®

Technical Handbook
2010–2012



tyco
Thermal Controls

Smart heat for comfort and safety

Smart heat for comfort and safety

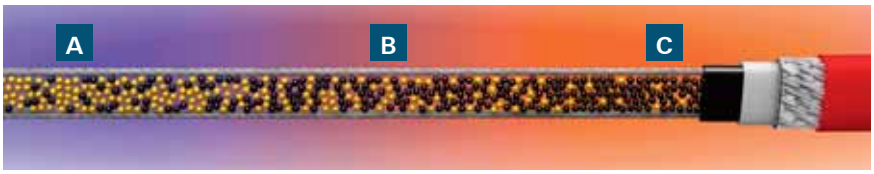
As the world leader in heat-tracing systems, Tyco Thermal Controls has the system that you need from pipe-freezing prevention or maintaining fluid temperatures, to melting snow and heating floors. After 35 years with unrivalled versatility and smart systems, Raychem's self-regulating cable technology still remains at the forefront in heat-tracing solutions. For commercial or residential applications, new construction or renovation, our smart solutions will perform perfectly for greater comfort and safety.

The heart of our solutions

In 1970, Raychem first developed and launched self-regulating electric heating cables.

The cable delivers the right amount of heat exactly when and where it is needed. As the temperature drops, more heat is produced. Conversely, as the temperature rises, less heat is produced. But there are many more benefits:

- The smart cables can be overlapped without any risk of overheating.
- The heating cables can be cut to length 'in the field'. This means additional flexibility when plans do not correspond to the "real life" situation on site.
- The length of pipe corresponds to the length of cable that you need.



A Cold ambient = High power output

If the temperature in the immediate vicinity of the self-regulating heating cable is cold, the heat output from the heating cable is increased. The polymeric core of the cable contracts, which creates many electrical paths across the integrated carbon particles.

B Warm ambient = Low power output

In response to a warmer environment, the heat output of the self-regulating cable is reduced. The polymeric core of the cable expands, reducing the electrical paths.

C Hot ambient = Virtually no output

If the temperature in the environment of the self-regulating heating cable reaches a high temperature, the heat output is minimal. Due to the maximum expansion of the polymeric core of the cable, most of the electrical paths are broken.

Tested and qualified

- Stringent production monitoring
- Approved BS EN 62395 (IEC 60800)
- VDE approved
- CE marked

Member of the European Radiant Floor Heating Association e.v.

Our products satisfy the requirements of the relevant European Directives.

Robust construction

- Long service life assured through modified polyolefin or fluorpolymer insulation and jacket materials.

Life time

- Intensive tests according to recognized scientific procedures. Results: self-regulating heating cables have a service life in excess of 20 years.

Raychem® Smart Services

It's not only the cable!

The combination of a self-regulating heating cable and a smart control unit allows for dynamic management of the heating cable's power output dependent on parameters such as ambient temperature and moisture. These will help you and your customers to comply with today's building regulations on energy savings. A complete Raychem system can result in energy savings of up to 80%!

Our control units (e.g. HWAT-ECO) are designed for easy set-up and operation. They are easy to access for fast wiring. Ergonomic buttons, intuitive menu-driven operation and pre-installed programmes allow for quick set-up.

Specific connection systems have been designed and configured to be fully compatible with our heating cables.

The RayClic connection system cuts installation time by 80%. Inserting the stripped cable into the module and tightening a few screws is all it takes.

Raychem offers a set of tools and services that aim to simplify the professional´s life. Not only do we offer the best quality products, we also support them with unrivalled services.

An efficient customer service centre

- Multi-lingual customer service representatives to answer all your questions
- Fast order handling & shipment Europe-wide
- Free documentation service

Large technical support team

- "On demand" technical advice
- Free designs and quotations
- Direct support to specifiers and installers
- Training support upon request
- Complete after-sales service
- Also for non-standard applications our team can assist you in finding the right heating solution. Do not hesitate to get in touch with us. Free phone 0800 96 90 13 or Free fax 0800 96 86 24.

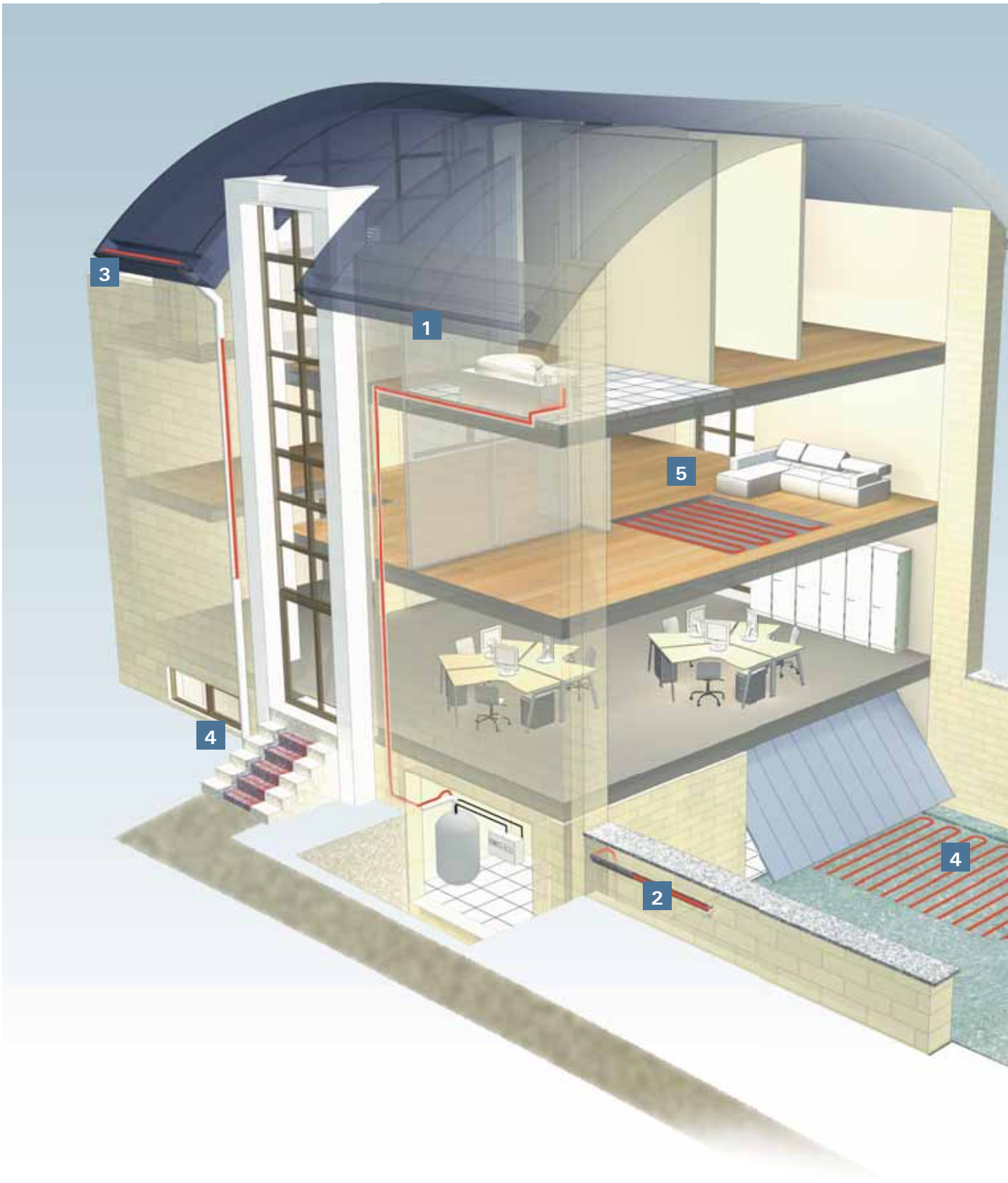
CIBSE

Tyco Thermal Controls is also a proud industry supporter offering approved CPD courses via the Chartered Institute of Building Services Engineers. Courses include technical and application information for electrical underfloor heating and hot water temperature maintenance systems.
For further information, please consult the CIBSE Course Directory 2010 or contact Tyco Thermal Controls.

www.tycothermal.com

Our website provides you with all information – from product selection to downloadable installation manuals.

Overview of applications



Hot water temperature maintenance

Providing the comfort of instant hot water is the key requirement of any modern hot water system.
The Raychem single-pipe system keeps water at the right temperature in a building's water distribution pipe work. The intelligent system first keeps the investment cost low and then it operates economically and efficiently.

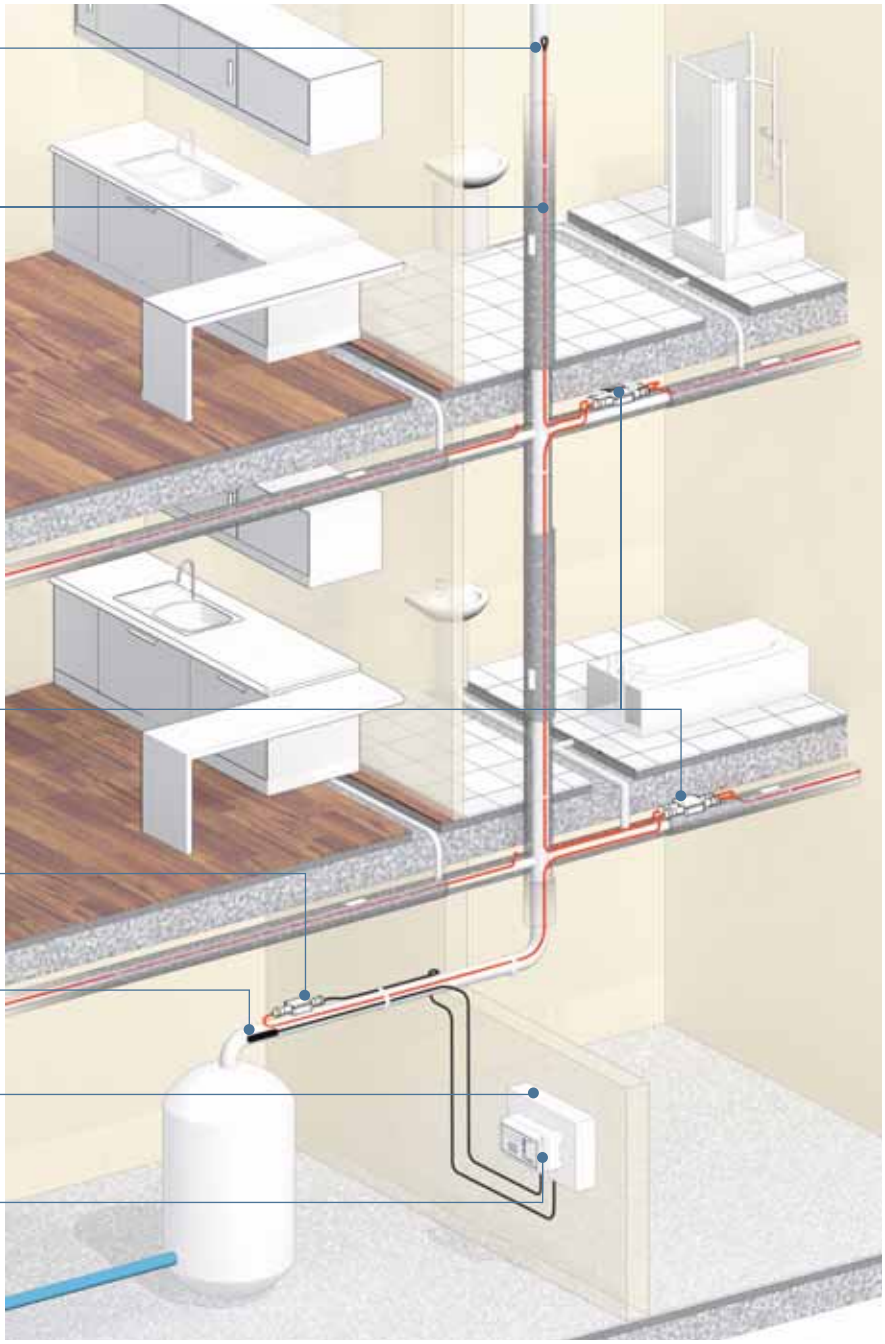
An hygienic system
Less water volume and less heat loss in the pipe work help prevent bacteriological problems.

A flexible and space-saving system
The space requirement for pipes has been reduced because there are no return pipes. Risers, shafts and openings can be optimised freeing space for other services.

Low investment costs
The heating cable is simply fixed on the supply pipe. There is no need for return pipe work, valves or pumps, nor for complex design and balancing work associated with return systems.

Lower power consumption
The heat loss in the system is significantly lower as only the heat loss from the feed pipe (and not from the return pipe) is to be compensated for. There is also no power requirement for circulation pumps.
The single-pipe system can be used with a smaller boiler and as there is no cold return water coming into the boiler, the heat-up of the water is more efficient.
The intelligent HWAT-ECO control unit saves power e.g. it can lower the temperature or switch off during water consumption peaks.

No maintenance costs
The system has no mechanical parts such as a recirculation pump or control valves. There are no parts to wear out.



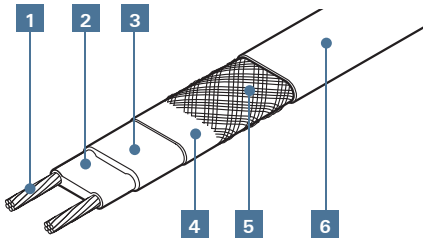
Design guide, control units and accessories

1. Heating cable selection

Optimum water temperature maintenance for single family houses, flats, offices, hotels, hospitals, convalescent homes, sports centres, ...

Heating cable type	HWAT-L	HWAT-M	HWAT-R
Power output	7W/m at 45°C	9 W/m at 55°C	12 W/m at 70°C
Max. exposure temperature	65°C	65°C	80°C
Outer jacket colour	yellow	orange	red
Control unit HWAT-ECO	–	recommended for enhanced energy - efficiency	essential
Legionella prevention			Possibility of thermal legionella prevention up to the draw-off points

2. Composition of the HWAT-L/M/R heating cable



1. Copper conductor (1.2 mm^2)
2. Self-regulating heating element
3. Modified polyolefin insulation
4. Aluminium foil wrap
5. Protective tinned copper braid
6. Modified polyolefin protective outer jacket.

Technical data: see page 11

3. Heating cable length

- The heating cable is installed in a straight line on the pipework
- The heating cable can be traced right up to the draw-off points

Total length of pipe to be traced
+ approx. 0.3 m per connection
+ approx. 1.0 m per T-connection
+ approx. 1.2 m per 4-way connection

= required heating cable length

4. Insulation thicknesses

Pipe size (mm)	15	22	28	35	42	54
Insulation thickness (mm)	20	20	25	30	40	50

Ambient temperature: 18°C
Thermal conductivity $\lambda = 0.035$ W/(m.K)
For other thermal conductivity insulation materials, contact your Tyco Thermal Controls representative.

5. Electrical protection

- The total length of heating cable determines the number and size of the circuit breakers
- Residual current device (rcd): 30 mA required
- Power cabling for the heating cables according to local regulations
- The power connection must be carried out by an approved electrical installer

Circuit-breaker to BSEN 60898 (type C): the maximum length of the heating circuit is based on a minimum start-up temperature of +12°C, 230 VAC.

	HWAT-L	HWAT-M	HWAT-R
10 A	80 m	50 m	50 m
13 A	110 m	65 m	65 m
16 A	140 m	80 m	80 m
20 A	180 m	100 m	100 m

Hot water temperature maintenance

6. Checklist for planning the installation

The system design should take into account:

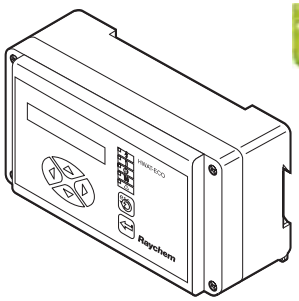
- Pipe diameter and material
- Insulation type and thickness
- Ambient temperature
- Circuits should divide the plumbing into logical segments
- Don't exceed the maximum circuit length
- Show connection locations on the drawings
- Locate power connections near the electrical panel
- Locate T-connections in accessible areas

7. Testing of the installation

See page 55

8. Control units

HWAT-ECO

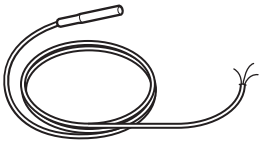


Electronic temperature control unit with integrated clock

- Building-specific programme
- Boiler temperature monitoring
- Economy programmes
- Password protection
- Simple user interface
- Compatible with HWAT-L/M/R heating cables
- BMS interface
- Alarm outputs

Technical data: see page 11

HARD-78

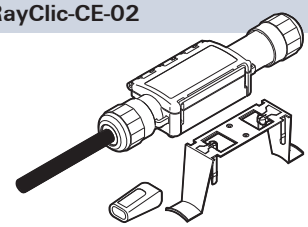


PT-100 temperature sensor (HARD-78) for assembly in sensor pipe installed on site.

- Diameter of sensor cable 4 mm
- Diameter of sensor element 6 mm
- Length of sensor element 50 mm
- Sensor length total 3 m

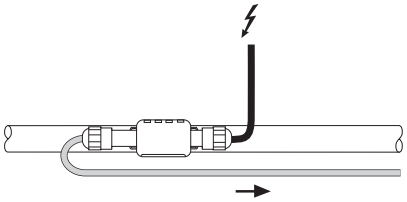
9. Accessories

RayClic-CE-02

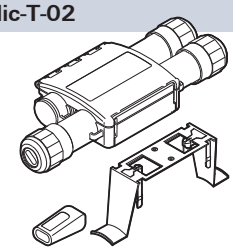


Power connection

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

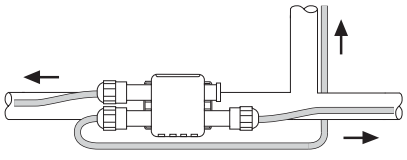


RayClic-T-02

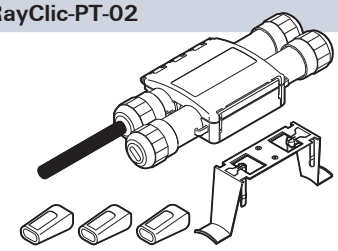


T-connection

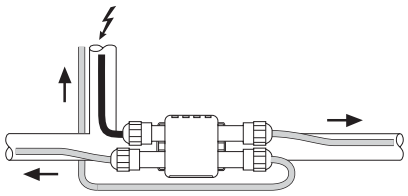
- Connection for 3 cables
- End seal and support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42 mm



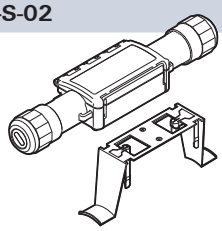
RayClic-PT-02



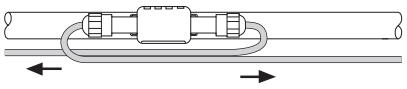
Power T-connection
- 3 connections with integral 1.5 m power cable
- 3 end seals and 1 support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42mm



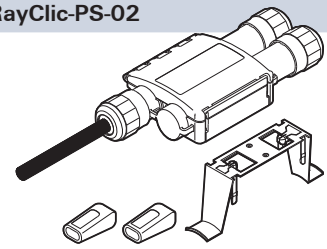
RayClic-S-02



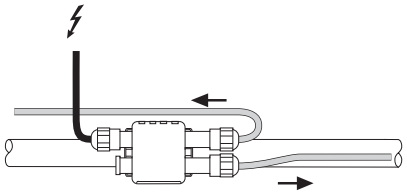
Splice for joining 2 lengths of heating cable
- Connection for 2 cables with 1 support bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm



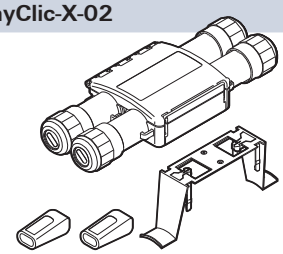
RayClic-PS-02



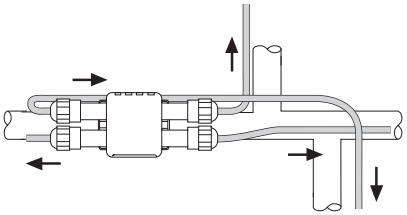
Powered splice
- Connection for 2 cables with integral 1.5 m power cable
- 2 end seals and 1 support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42 m



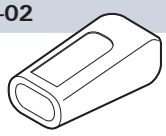
RayClic-X-02



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

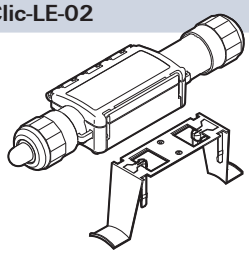


RayClic-E-02



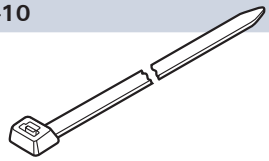
Gel-filled end seal
- For system extensions (to be ordered separately)
- IP 68

RayClic-LE-02



RayClic with illuminated end seal
- For visual representation of voltage (by green lamp)
- 1 retaining bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm

KBL-10



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

Use ATE-180 on plastic pipes

Hot water temperature maintenance

GT-66

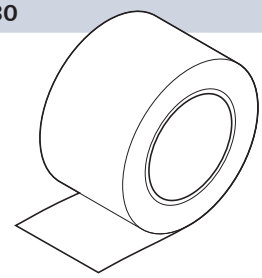
Heat-resistant glass cloth tape
- For steel pipes or for any installation below 4.4°C
- 20 m roll for approx. 20 m of pipework

Use ATE-180 on plastic pipes

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

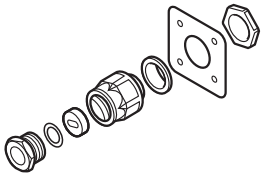
ATE-180



Aluminium adhesive tape
- Heat resistant up to 150°C
- 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 (for HWAT-L, -M) /IEK-25-04 (for HWAT-R)



Insulation entry kit
- Insertion of heating cable in metal cladding
- Consists of: metal fasteners, metric gland and joint seal

LAB-I-01

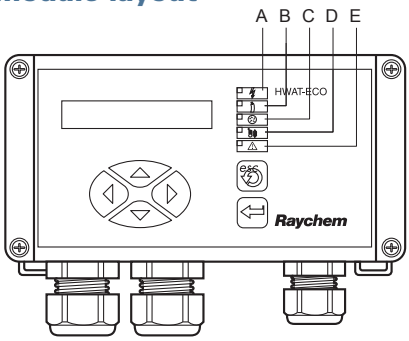
Electric traced label
- To be placed at 5 m intervals on insulation surface

10. General installation instruction

See page 55

HWAT-ECO Temperature control unit

Module layout



A Power supply on (green LED)

B Power to heater on (green LED)

C Legionella prevention (green LED) - heating cable 100% powered - increased risk of scalding

D Maintain temperature lowered following boiler temperature decrease (green LED) - boiler temperature is lower than expected.

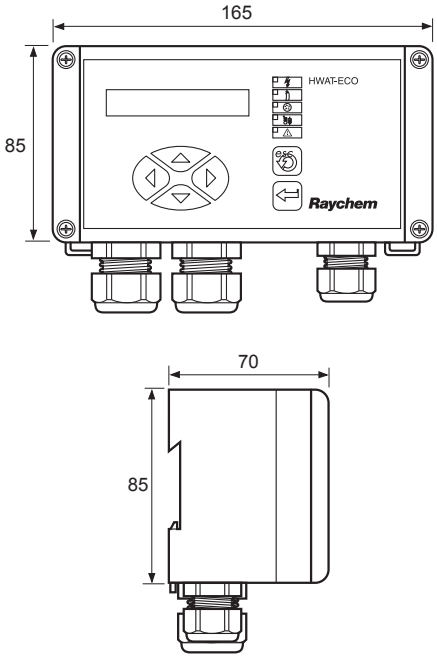
E Error (red LED)

Change menu selection or position cursor

Escape, backspace or NO

Confirm selection, new value or YES

Technical data



(Dimensions in mm)

Product description	HWAT-ECO
Use	Only for HWAT-L/M/R heating cables
Selectable maintain temperature	37 °C to 65 °C in max. 48 timer blocs per day
Operating voltage	230 VAC (+10%, −10%), 50 Hz
Switching capacity	20 A / AC 230V
Internal power consumption	2,5 VA
Circuit breaker	Max. 20 A, C-Characteristic
Power cable section entry	1.5 - 4 mm^2 for fixed wiring only
Auxiliary cable section entry	Up to 16 AWG (1.3 mm^2)
Weight	880 g
Mounting options	Wall mount with 2 screws or DIN rail
Cable glands (entries)	2 x M20 and 1 x PG13.5 with 3 inputs for external wires of 3-5 mm
Protection level	IP 54
Ambient temperature	0°C to 40°C
Housing material	ABS
Internal temperature alarm	85 °C
Master/slave cable	2-wire twisted pair shielded, max. 1.3 mm^2 core and insulation of 500 V
Master/Slave	Master is selectable in the unit, up to 8 slaves can be connected
BMS interface	0 - 10 VDC
Alarm relay contacts	Max. 24VDC or 24 VAC, 1 A, SPDT voltage free
Boiler temperature sensor	PTC KTY 81-210 or PT 100 2-wire
Power correction factor	60% to 140% (fine tuning of maintained temperature)
Clock back-up time	Min. 1 year with lithium battery CR2025 (3V)
Clock accuracy	±10 minutes per year
Real time clock	Automatic summer/winter time and leap year correction
Parameters stored in non-volatile	All parameters, except date and time memory
Approval	VDE according to EN 60730
EMC	According to EN 50081-1/2 for emission and EN 50082-1/2 for immunity

Raychem requires the use of a 30 mA residual current device and a C-Characteristic circuit breaker to provide maximum safety and protection from fire.

The unit complies with IEC1000-3-3 (flicker) if installed according to part 3 of VDE 0838. To avoid flicker install the unit in such a way that at the current value of the systems start-up temperature (max. 20 A per heating circuit) the voltage drop does not exceed 1% at the power supply of the lighting apparatus (normally subpanel).

Hot water temperature maintenance

Programme

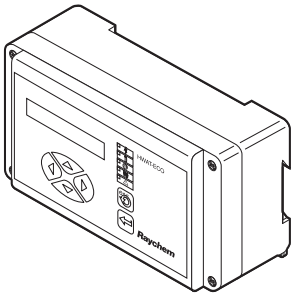
The HWAT-ECO has 7 different building specific time/temperature programmes. These programmes are based on our long experience for optimum comfort and energy saving. For user specific changes in the programming, the Edit timer programme can be used.

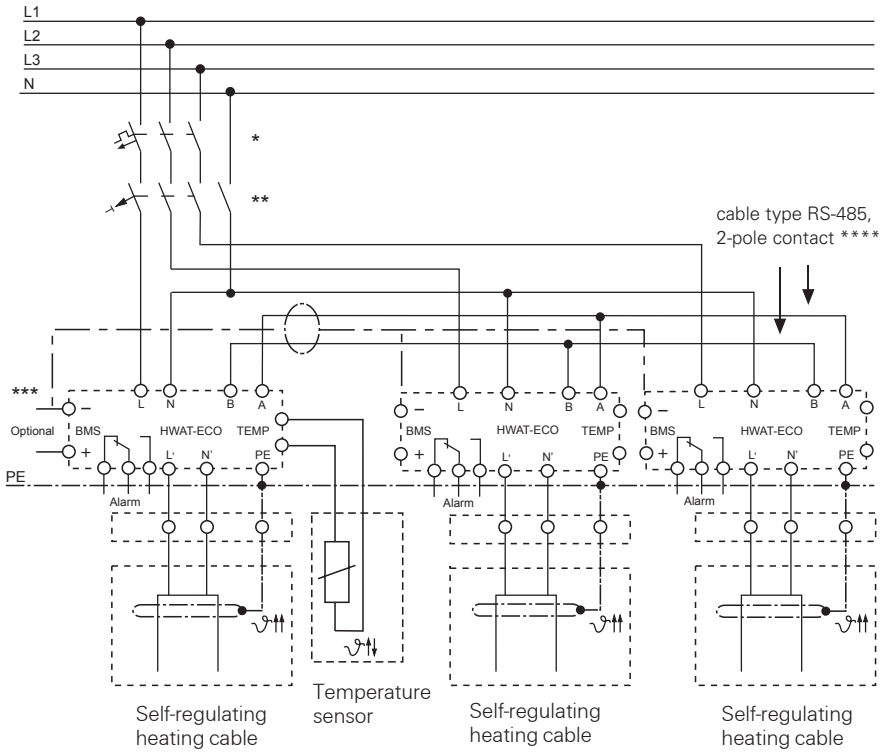
Programme name	Building type
Programme 0	Constant temperature (±55°C)
Programme 1	Apartment block
Programme 2	Prison / Barracks
Programme 3	Hospital
Programme 4	Hotel
Programme 5	Sports centre / Swimming pool
Programme 6	Office

In addition, user specific programmes can be created

Temperature can be varied in 1/2 h blocks to any desired temperature between: OFF, economy t°, maintain t° and legionella prevention (100% powered, increased risk of scalding)

Wiring diagram for HWAT-L / HWAT-M / HWAT-R with HWAT-ECO temperature control unit





* 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

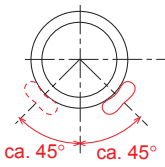
*** Optional: Potential-free circuit-breaker for connection to the BMS

**** The earth wire of shielded RS-485 cable needs to be connected to the BMS (-) terminal of each HWAT-ECO in the Master / Slave network.

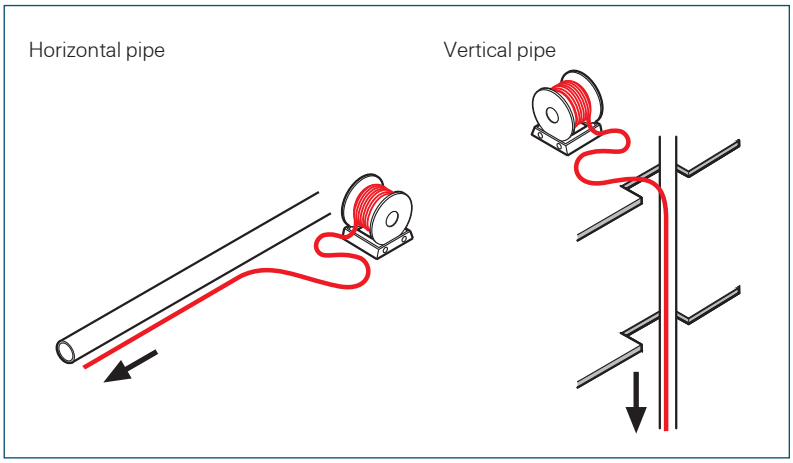
Hot water temperature maintenance

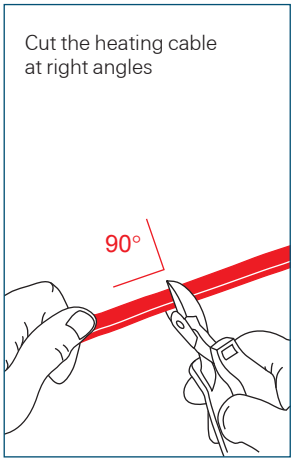
11. Installation instructions for HWAT-L/M/R cables

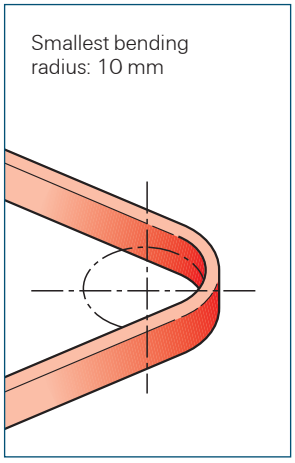
- The heating cable should be installed in a straight line on the pipework.
- Install on dry surfaces
- Minimum installation temperature: −10°C

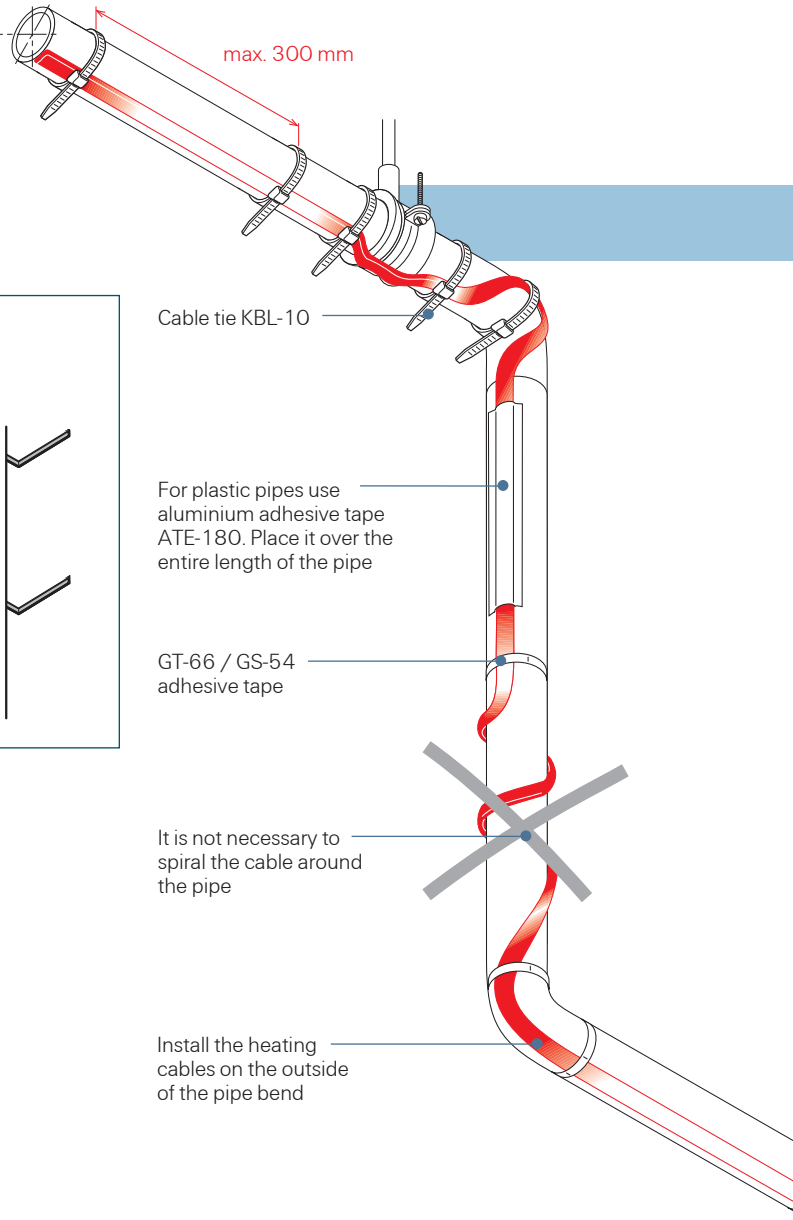


horizontal pipes



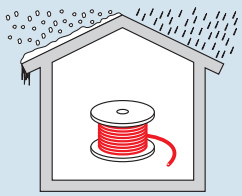






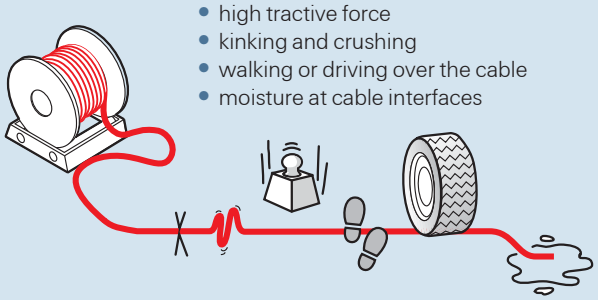
Installation of self-regulating heating cables

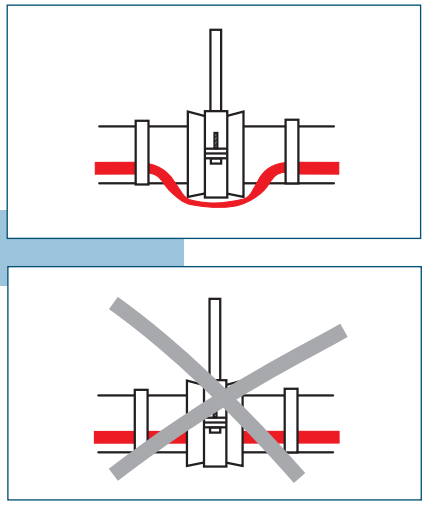
- Store in a dry and clean place.
- Temperature range: −40°C to +60°C.
- Protect any cable ends with an end seal.



Avoid:

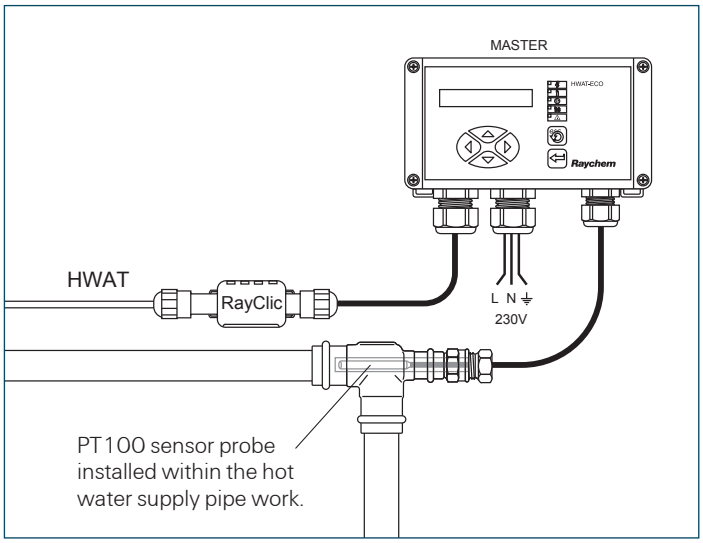
- sharp edges
- high tractive force
- kinking and crushing
- walking or driving over the cable
- moisture at cable interfaces

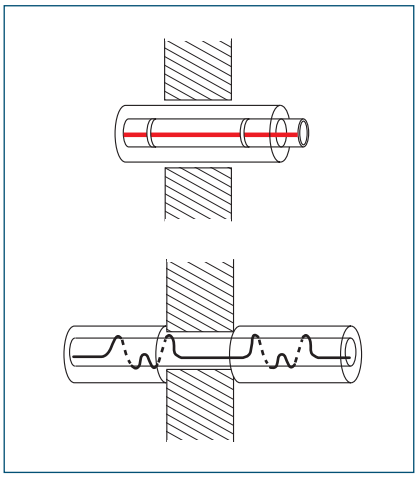




- Run the cable over pipe suspensions
- Do not clamp the cable

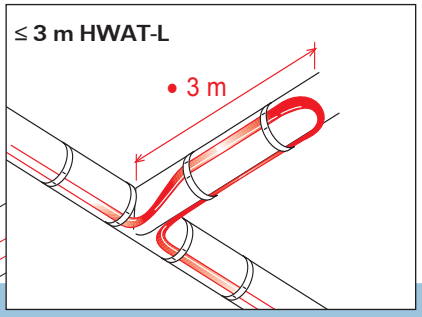
Standard Installation of PT100 Sensor with in-pipe sensor probe.

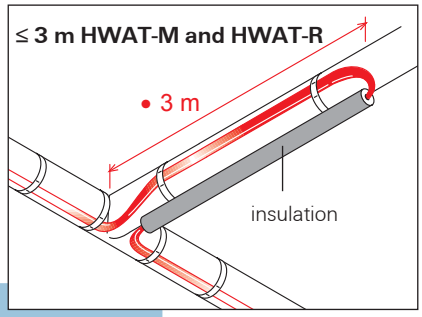


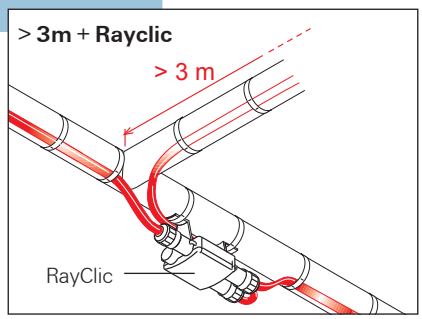


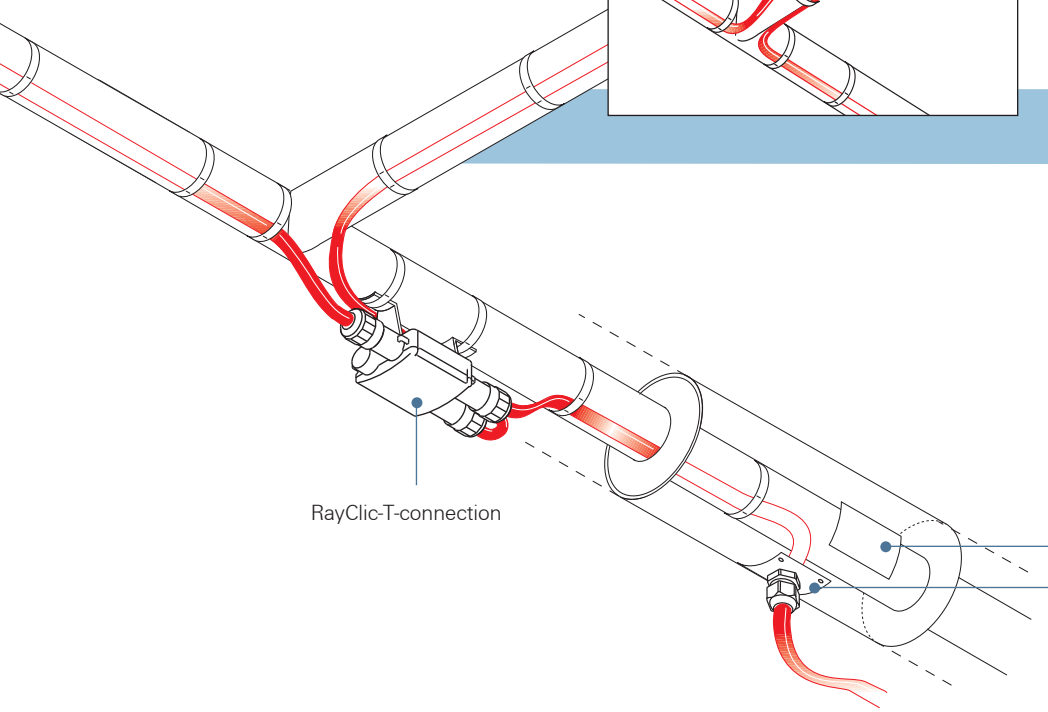
Wall/Floor transit

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









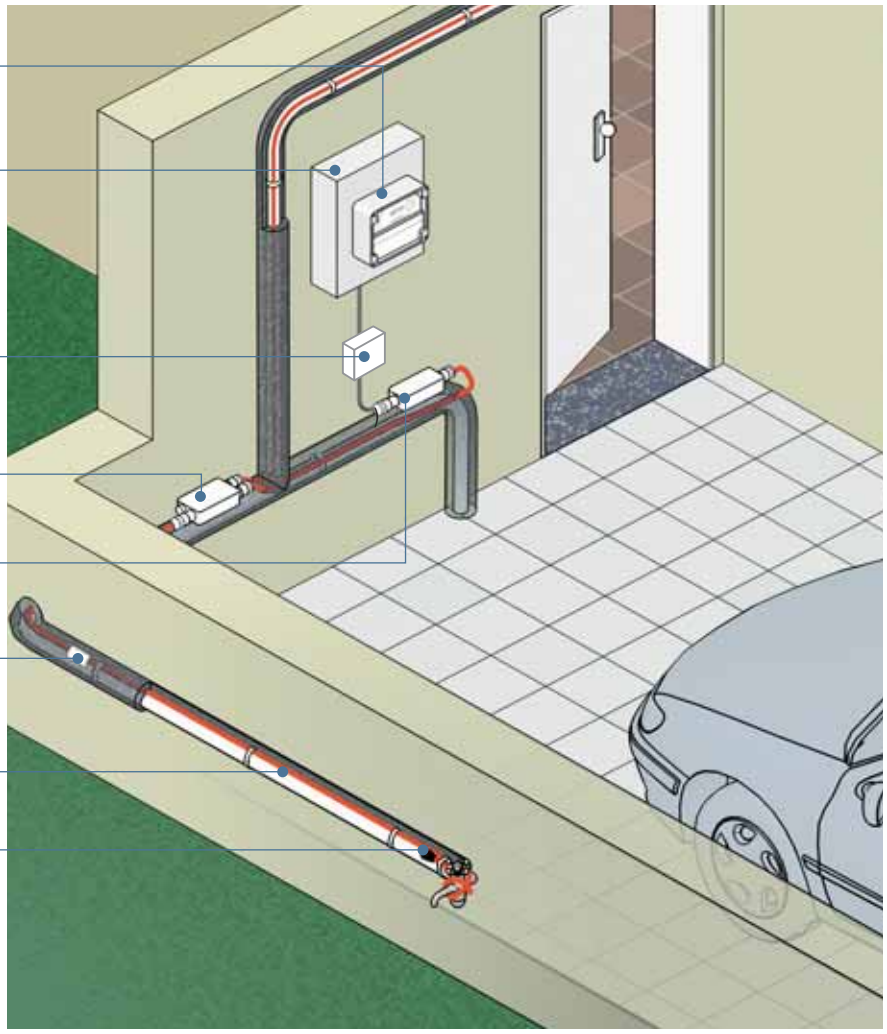
Frost protection for pipes

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.

Easy to install
The heating cable is simply fixed onto 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 protects it from severe environmental conditions.

Low power consumption
The smart RAYSTAT -ECO control unit calculates a duty-cycle proportional to the expected minimum temperature. Where a simple ambient thermostat would energize the heating cable for 100%, the "smart" controller would energize 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

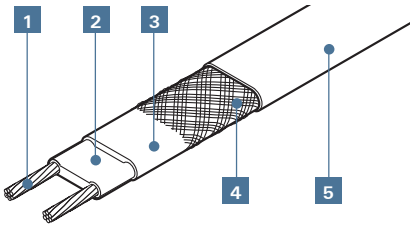
Frost Protection for pipework to maximum 90°C operating temperature. For long circuit applications and central heating pipework.

FS-C10-2X	10 W/m at 5°C

TraceCalc Net™

TraceCalc.Net Construction is a software tool for product selection based on actual project data. Visit <http://www.tycothermal.com/uk/english/heat_tracing/software/industrial_design/default.aspx> for more information.

2. Composition of the FS-A/B/C/C10-2X 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

Note: FS-C10-2X comprises copper conductors (1.4 mm²)

3. Insulation selection

Frost protection down to –20°C.

Insulation thicknesses	mm / Inches	Pipe diameter 15 1/2″	22 3/4″	28 1″	35 5/4″	42 11/2″	54 2″	67 21/2″	76 3″	108 4″	125 5″	150 6″	200 8″
10 mm		FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X					
15 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X			
20 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X		
25 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	
30 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X
40 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X
50 mm		FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**A**-2X FS-C10-2X	FS-**B**-2X	FS-**B**-2X	FS-**B**-2X

Frost protection cables FS-A-2X, FS-B-2X and FS-C10-2X 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 λ = 0.035 W/(m.K) or better.

Important note: frost protection heating cables with fluorpolymer 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	mm / Inches	Pipe diameter (mm) 42 11/2″	54 2″	67 21/2″	76 3″	108 4″	125 5″	150 6″	200 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 λ = 0.035 W/(m.K) or better.

Frost protection for pipes

Cable type FS-C-2X should only be used in conjunction with pipework with a minimum continuous temperature resistance of 90°C. A line-sensing control thermostat (type AT-TS-14, RAYSTAT-CONTROL-10 or RAYSTAT-CONTROL-11-DIN) must be used on plastic pipework (setting approx. 40°C).

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 dead legs.
(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.

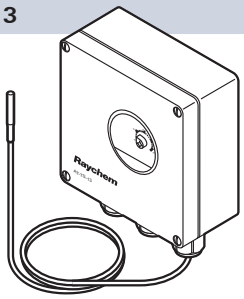
	FS-A-2X	FS-B-2X	FS-C-2X	FS-C10-2X
4 A	45 m	25 m	20 m	45 m
6 A	70 m	35 m	30 m	70 m
10 A	110 m	65 m	55 m	110 m
13 A	130 m	85 m	70 m	130 m
16 A	150 m	105 m	90 m	150 m
20 A	–	–	–	180 m

6. Testing of the installation

See page 55

7. Thermostats

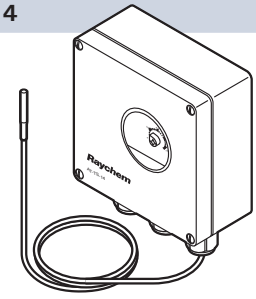
AT-TS-13



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

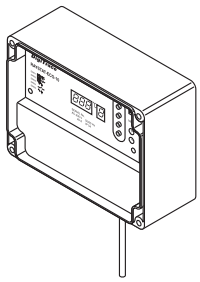
AT-TS-14



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

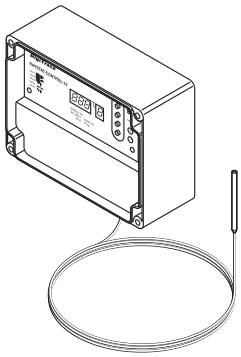
RAYSTAT-ECO-10



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

Technical data: see page 26

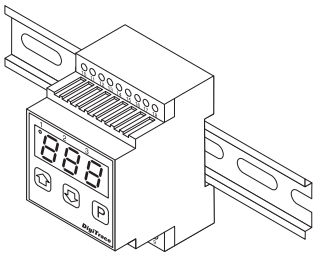
RAYSTAT-CONTROL-10



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 30

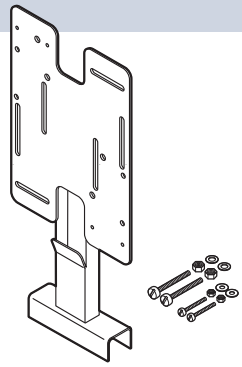
RAYSTAT-CONTROL-11-DIN



Line sensing thermostat with digital display for DIN rail mounting applications.
- Set temperature range: 0 - 65°C.
- Digital display of maintain temperature and alarm information. 16A switching.
- Low temperature alarm function
- DIN rail / Panel mountable control.
- Sensor type: PT100.

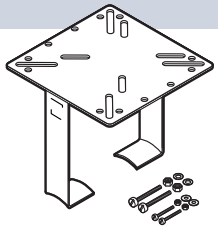
Technical data: see page 32.

SB-100



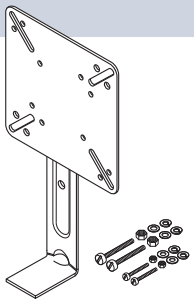
Stainless steel support bracket
- Specially constructed to provide heating cable protection between pipe and junction box via a tubular leg.
- For use with AT-TS-13, AT-TS-14, JB16-02 and RAYSTAT-CONTROL-10

SB-101



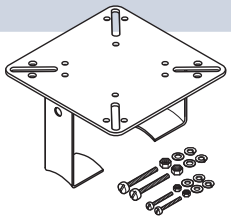
Dual-leg support bracket, stainless steel
- Height leg: 160 mm
- For use with AT-TS-13, AT-TS-14, JB16-02 and RAYSTAT-CONTROL-10

SB-110



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

SB-111



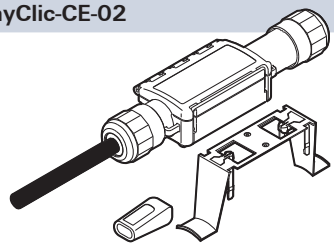
Support bracket, stainless steel
- Height leg: 100 mm
- For use with AT-TS-13, AT-TS-14, and JB16-02

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

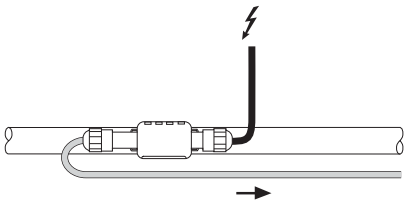
	FS-A-2X FS-B-2X
Power connection	RayClic-CE-02
Splice	RayClic-S-02
Powered splice	RayClic-PS-02
T-connection	RayClic-T-02
Powered T-connection	RayClic-PT-02
Four way connection	RayClic-X-02

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

RayClic-CE-02

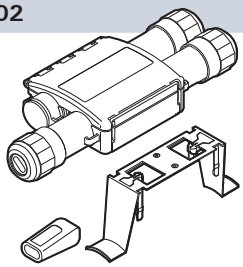


Power connection
- With 1.5 m power cable
- End seal and support bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm

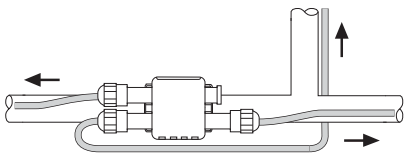


Note: RayClic components are not compatible with FS-C-2X /FS-C10-2X

RayClic-T-02

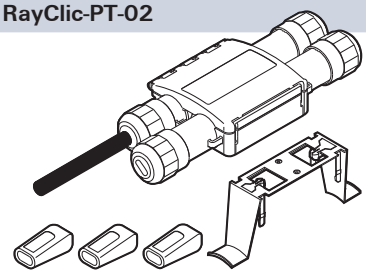


T-connection
- Connection for 3 cables
- End seal and support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42 mm



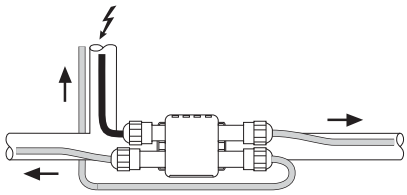
Note: RayClic components are not compatible with FS-C-2X /FS-C10-2X

RayClic-PT-02



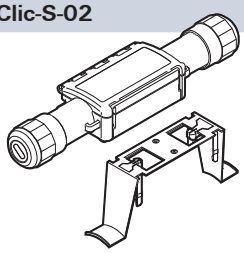
Power T-connection

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



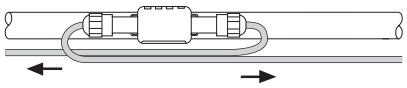
Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

RayClic-S-02



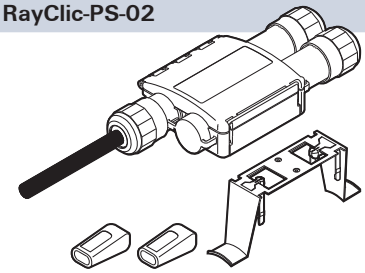
Splice for joining 2 lengths of heating cable

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



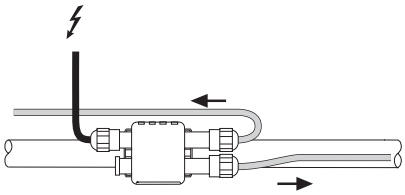
Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

RayClic-PS-02



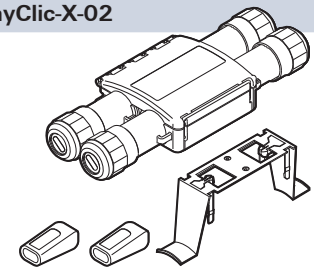
Powered splice

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



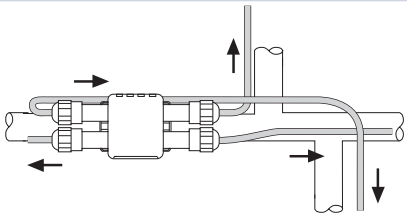
Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

RayClic-X-02



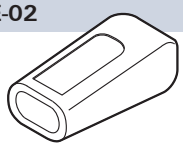
4-way connection

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



Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

RayClic-E-02



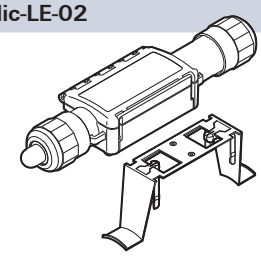
Gel-filled end seal

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

Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

Frost protection for pipes

RayClic-LE-02



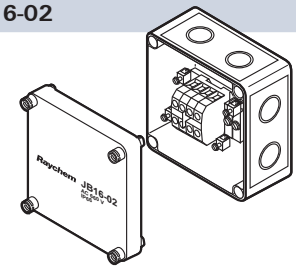
RayClic with illuminated end seal
- For visual representation of voltage (by green lamp)
- 1 retaining bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm

Note: RayClic components are not compatible with FS-C-2X/FS-C10-2X

9. Accessories for FS-C-2X, FS-C10-2X and BTV-2-CT cables

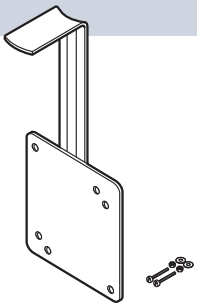
			For BTV-2-CT				For FS-C-2X/ FS-C10-2X		
Power connection	1 JB16-02	+	1 C25-21	+	1 E-06	+	1 CE20-01	+	JB-SB-08
Splice	1 JB16-02	+	2 C25-21	+	1 E-06	+	2 CE20-01	+	JB-SB-08
Powered splice	1 JB16-02	+	2 C25-21	+	2 E-06	+	2 CE20-01	+	JB-SB-08
T-connection	1 JB16-02	+	3 C25-21	+	2 E-06	+	3 CE20-01	+	JB-SB-08
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



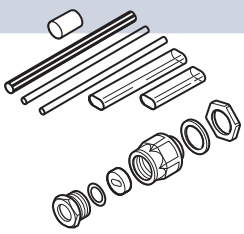
Temperature-resistant junction box
- For FS-C-2X, FS-C10-2X and BTV-2-CT
- For power connection or T-connection
- IP66
- 6 x 4 mm^2 terminals
- 4 Pg 11/16, 4 M20/25 knock-out entries

JB-SB-08



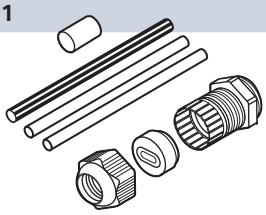
Single-leg support bracket
- for junction and connection box JB16-02

CE20-01



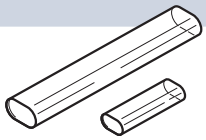
Connection and end seal kit for FS-C-2X/FS-C10-2X cables
- Heat-shrink technique
- M20 gland

C25-21



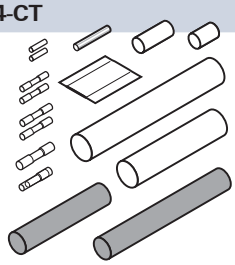
Connection kit for BTV2-CT
- Heat-shrink technique
- M25 gland

E-06



End seal kit for BTV2-CT

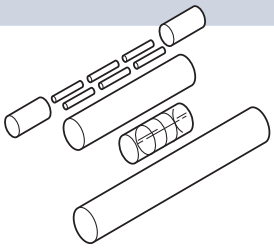
CCE-04-CT



Cold lead connection and end seal kit
- Connection of 3 x 1.5 mm^2 or 3 x 2.5 mm^2 cold lead cable to self-regulating heating cables BTV-CT, FS-C -2X and FS-C10-2X.

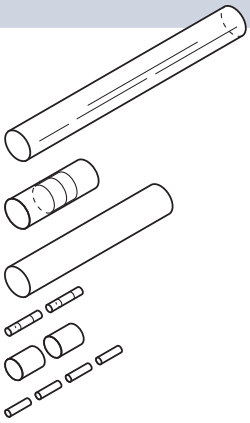
10. General accessories

S-06



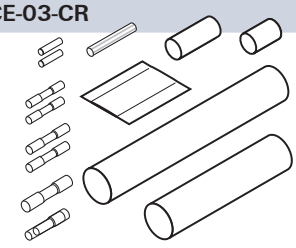
In-line splice kit
- for FS-A-2X and FS-B-2X

S-19



In-line splice kit
- for FS-C-2X , FS-C10-2X and BTV-2-CT

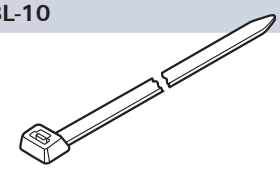
CCE-03-CR



Cold lead connection and end seal kit
- Connection of 3 x 1.5 mm^2 or 3 x 2.5 mm^2 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

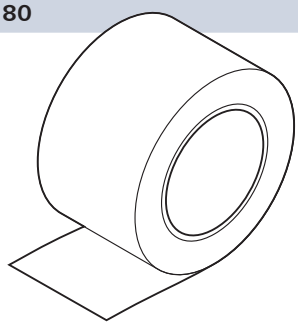
Heat-resistant glass cloth tape
- For steel pipes or for any installation below 4.4 °C
- 20 m roll for approx. 20 m of pipework

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

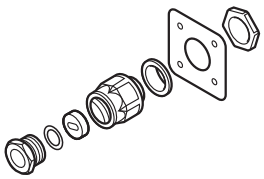
ATE-180



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

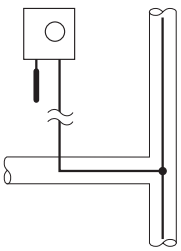
Electric traced label
- To be placed at 5 m intervals on insulation surface

11. General installation instructions

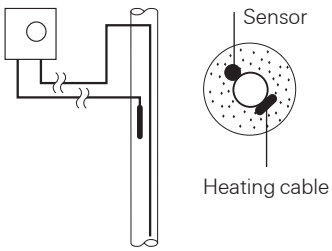
See page 55

12. Special installation instructions

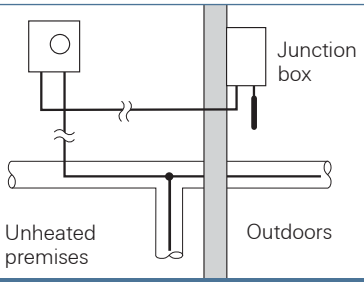
Placing of sensor



Ambient sensor



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

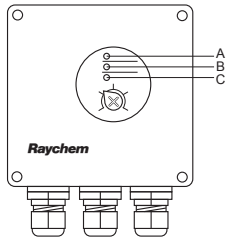


Always place the sensor in the coldest part of the installation

Frost protection for pipes

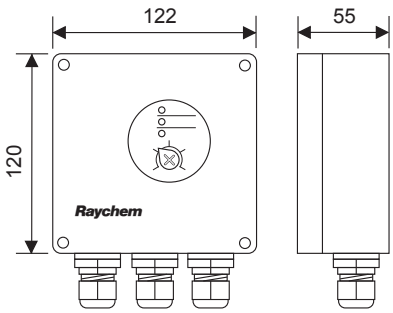
Line-sensing control and ambient thermostats (AT-TS-13 and AT-TS-14)

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 mm²	
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

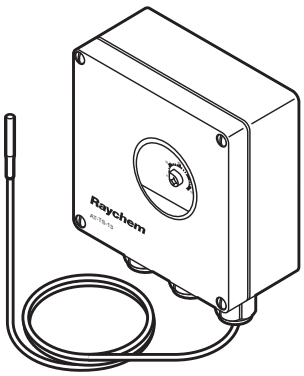
Temperature sensor (HARD-69)

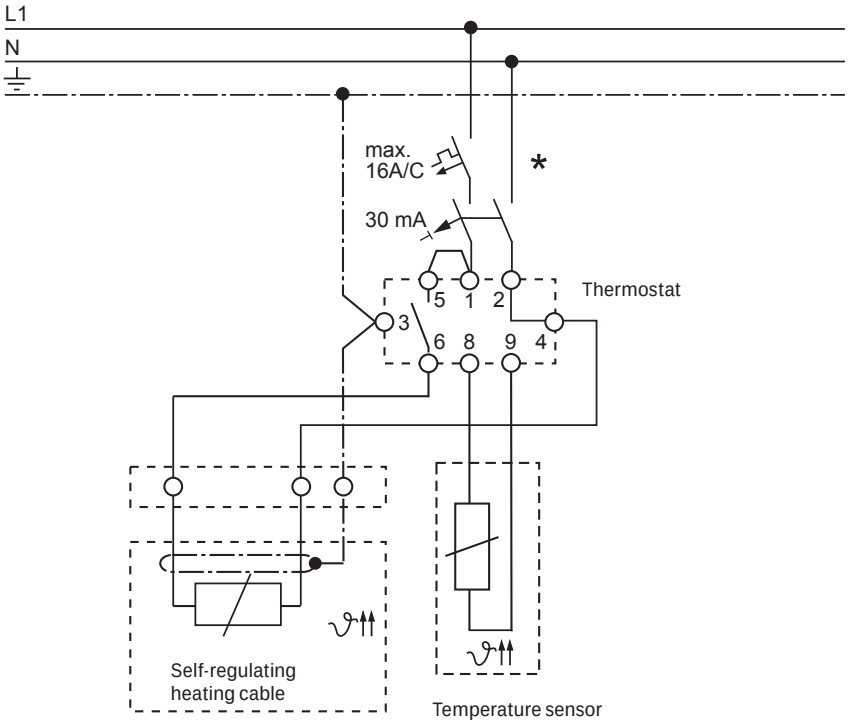
Type	PTC KTY 83-110
Length sensor cable	3 m
Diameter sensor cable	5.5 mm
Diameter sensor head	6.5 mm
Max. exposure temperature sensor cable	160 °C

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.

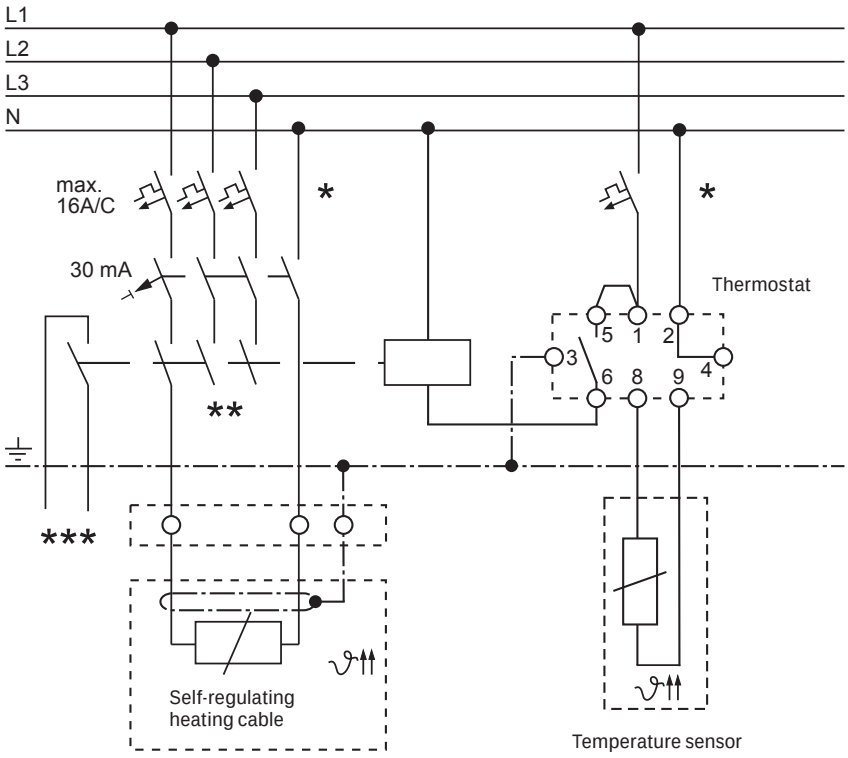
Wiring diagram for thermostat AT-TS-13 or AT-TS-14

AT-TS-13/14 direct





AT-TS-13/14 with contactor



* Two- or four-pole electrical pro-tection by circuit-breaker may be needed for local circumstances, standards and regulations

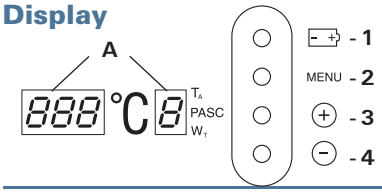
** Depending on the application, one- or three-pole circuit-breakers or contactors may be used

*** **Optional:** Potential-free circuit-breaker for connection to the BMS

Frost protection for pipes

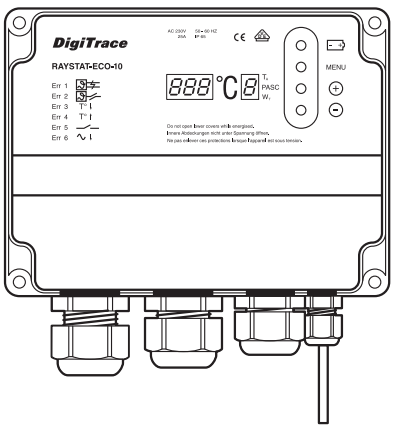
Energy saving frost protection controller RAYSTAT-ECO-10

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 mm² to 4 mm²
Alarm Relay	I_{max} 2 A, 250 VAC, SPDT, voltfree
Alarm Terminals	(3 + ⏚) x 0.75 mm² to 2.5 mm²
Accuracy	±0.5 K at 5 °C

Main parameter settings

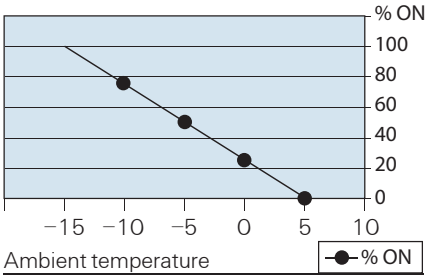
Energy Saving Algorithm	Proportional Ambient Sensing Control (PASC) active below setpoint
Temperature Setpoint	0 °C to + 30 °C (switch off temperature)
Minimum Expected Ambient Temperature	−30 °C to 0 °C (heating 100% powered)
Heater Operation if Sensor Error	ON (100%) or OFF
Voltage Free Operation	YES 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

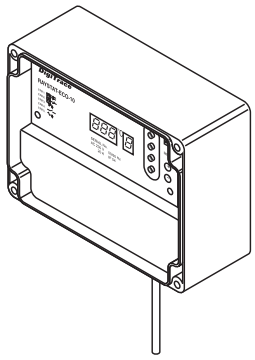
Temperature sensor

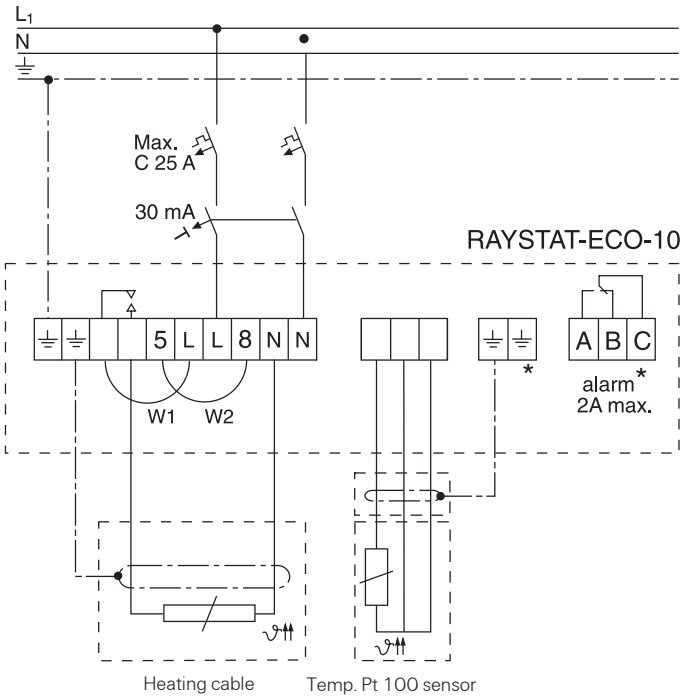
Sensor Type	3-wire Pt100 according to IEC Class B
Sensor Head	6 mm

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 bve shielded if it is laid in cable ducts or in the vicinity of high-voltage cables.

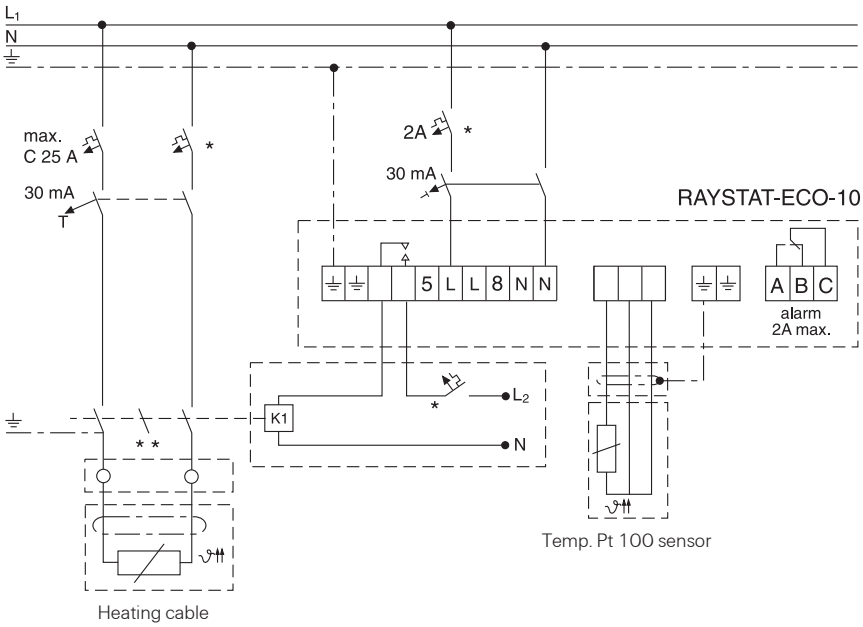
Wiring diagram for RAYSTAT-ECO-10

Normal operation





Voltage Free operation: Remove links W1 and W2



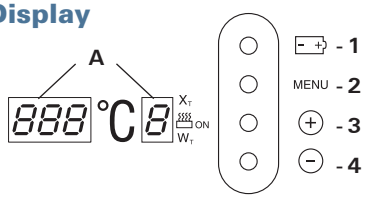
* Electrical protection by circuit breaker may be needed for local circumstances, standards and regulations.

** 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

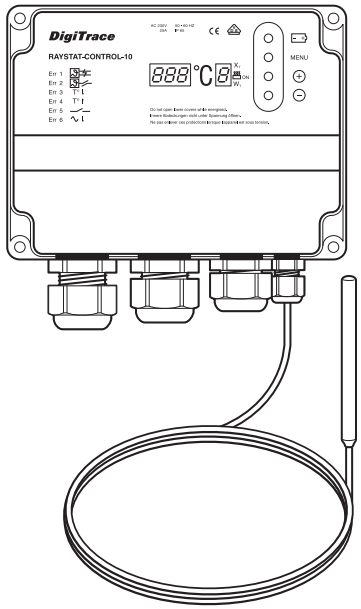
Display



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 mm² to 4 mm²
Alarm Relay	I_{max} 2 A, 250 VAC, SPDT, voltfree
Alarm Terminals	(3 + ⏚) x 0.75 mm² to 2.5 mm²
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

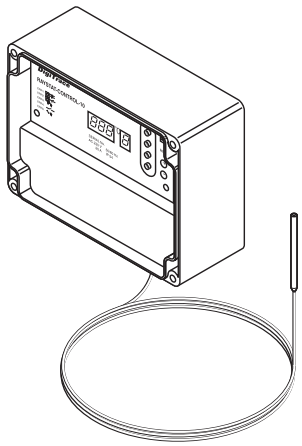
Temperature sensor

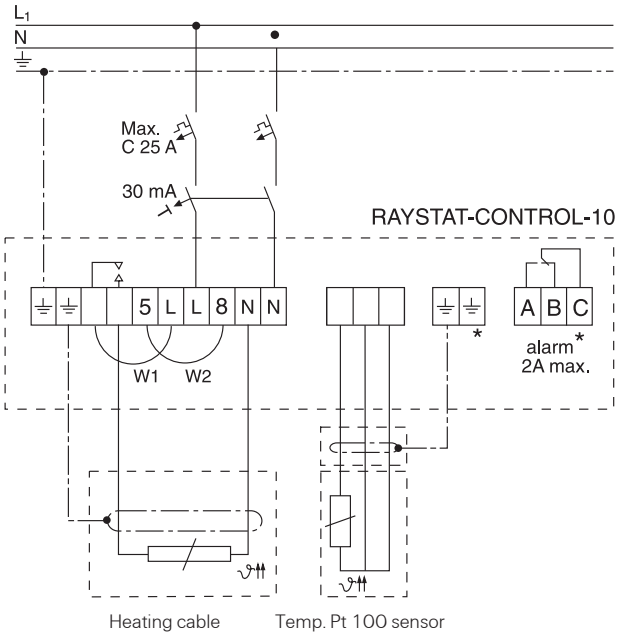
Sensor Type	3-wire Pt100 according to IEC / Class B
Sensor Head	50 mm x Ø 6 mm
Sensor Cable Length	3 m x Ø 4 mm
Cable Exposure Temperature	−40°C to +150°C (+215°C, 1000 h max.)

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.

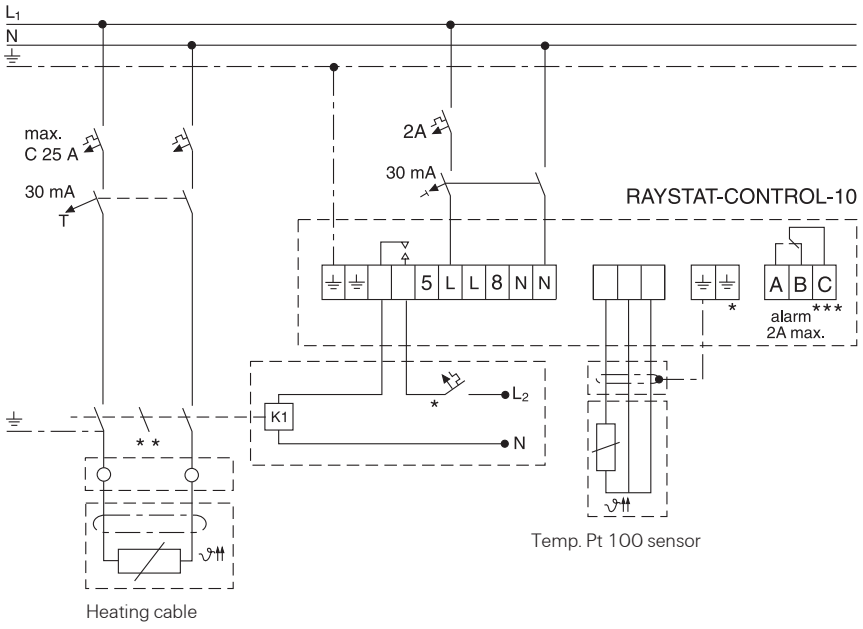
Wiring diagram for RAYSTAT-CONTROL-10

Normal operation





Voltage Free operation: Remove links W1 and W2



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

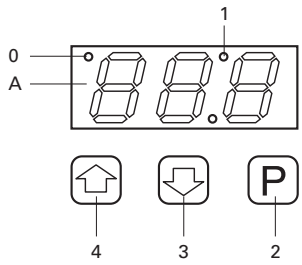
** Depending on the application, one or three-pole circuit breakers or contactors may be used

*** Optional

Frost protection for pipes

RAYSTAT-CONTROL-11-DIN — Line-sensing thermostat for rack mounting with alarm relay

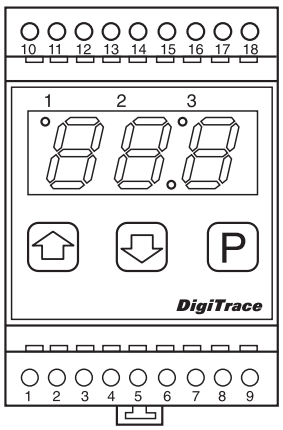
Display



A. LED display (parameter and error indications)

- **0.** Control relay ON
- **1.** Alarm relay activated
- **2.** Programming button
- **3.** Reduce value
- **4.** Increase value

Technical data



Operating voltage	230 Vac, +10%/–10%, 50/60 Hz
Power consumption	≤5 VA
Control relay (heating)	I_{max} 16 A, AC 250 V, SPST
Connecting terminals	2.5 mm² screwed
Alarm relay	I_{max} 8 A, AC 250 V, SPDT, voltage-free
Accuracy	±1 K at 0 to 50°C
Operating temperature	–10°C to +55°C
Storage temperature	–20°C to +60°C

Programmable parameter settings		**Factory setting**
Temperature setting	0°C to +63°C	5°C
Hysteresis	1 K to 5 K	1 K
Low temperature alarm	–15°C to 0°C or „Off" position.	0°C
Heater operation if sensor error	ON or OFF	ON
Voltage-free operation	YES	

Diagnosed errors	
Sensor error	Sensor short-circuit / Sensor open-circuit / 3-wire sensor missing
Temperature error	Low temperature

All parameters are stored in a non-volatile memory.

Housing

Dimensions	51.5 mm x 87.5 mm x 58 mm (W x H x D)
Material	Housing in ABS
Ingress protection	IP 20 (IP 30 installed in switchgear cabinet)
Mounting	DIN 35 mm rack mounting

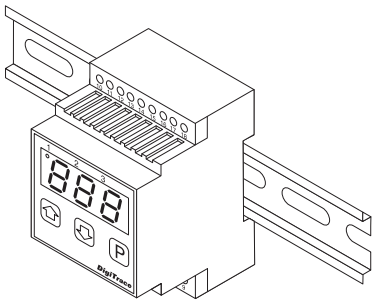
Temperature sensor

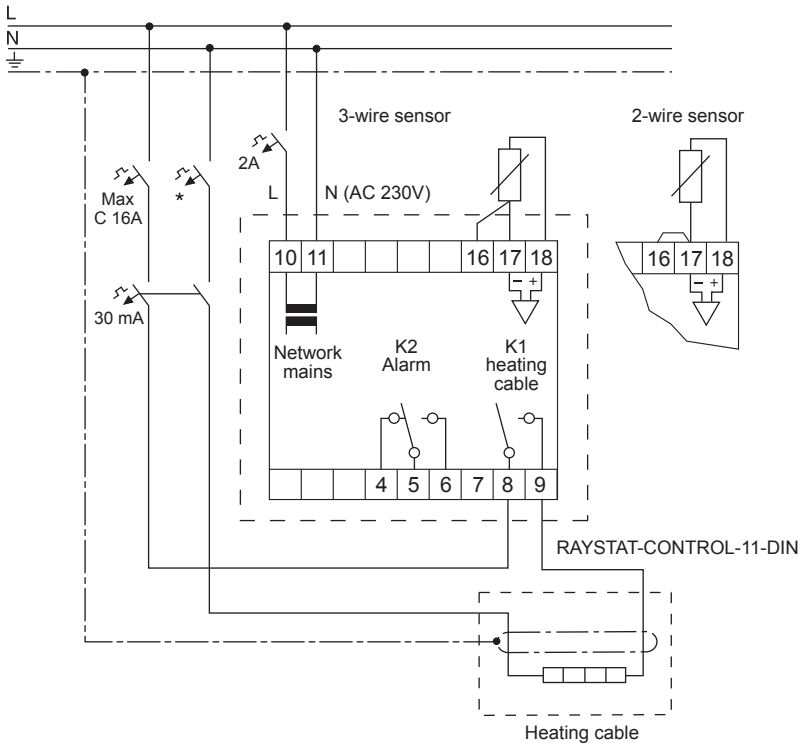
Type	Pt 100 (3-wire technology) as per IEC class B
Sensor element	50 mm x Ø 6 mm stainless steel sheath
Protection rating	IP 68
Sensor cable length	3 m x Ø 5 mm
Ambient temperature	–50°C to 105°C

The sensor can be extended with a 3-wire shielded cable with max. 7.5 Ω per wire (with 3 x 1.5 mm² max. 150 m). The shielding should be earthed in the switchgear cabinet.

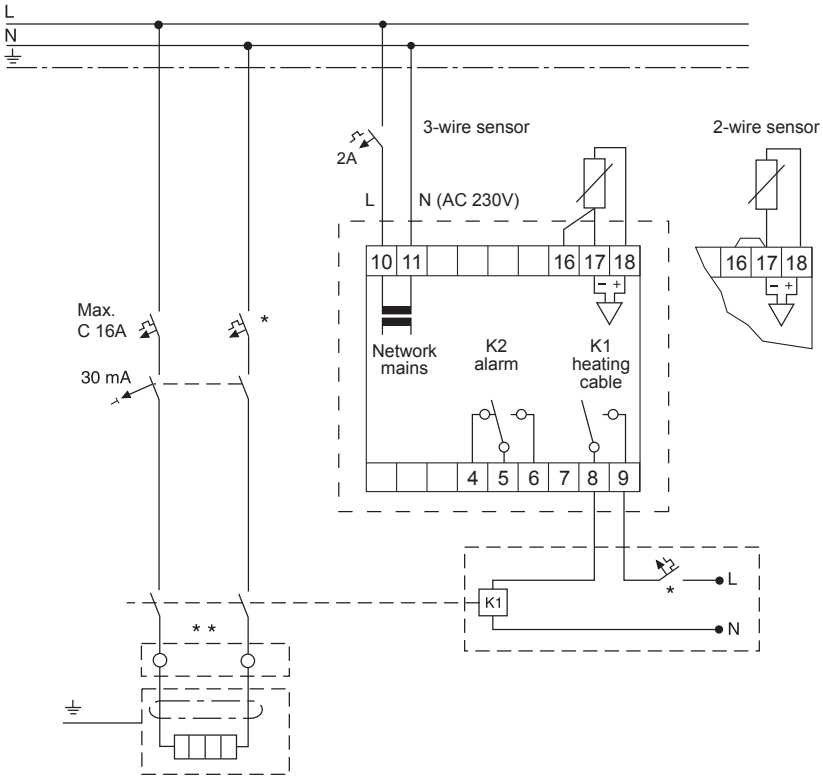
Wiring diagram for RAYSTAT-CONTROL-11-DIN

Normal operation





Voltage-free operation with power contactor



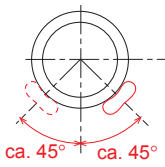
* Regional factors, standards and regulations may require two to four-pole disconnection by circuit breakers / ground fault circuit interrupters.

** Depending on the application, both single and multipole contactors are possible.

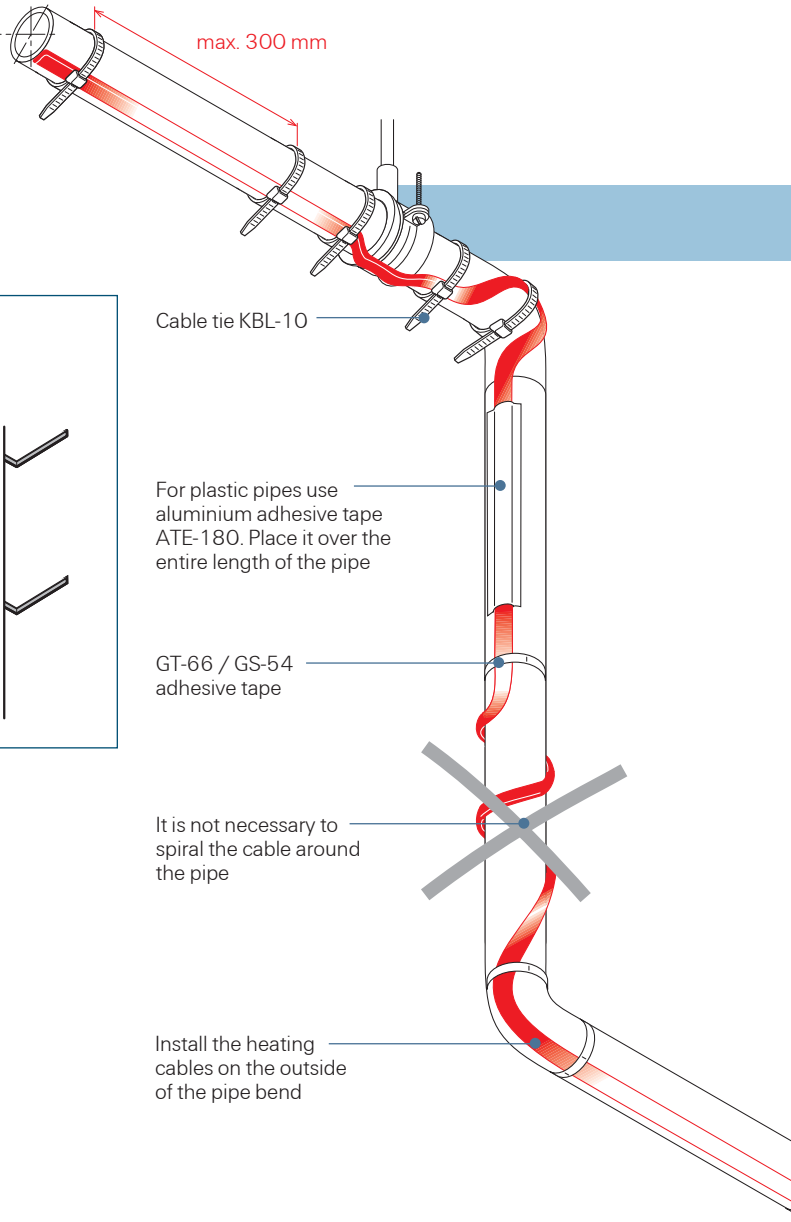
Frost protection for pipes

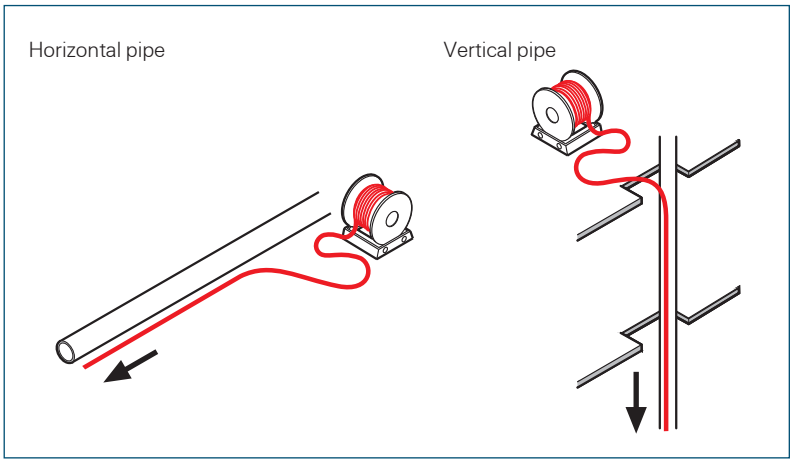
11. Installation instructions for FS-A/B/C/C10-2X cables

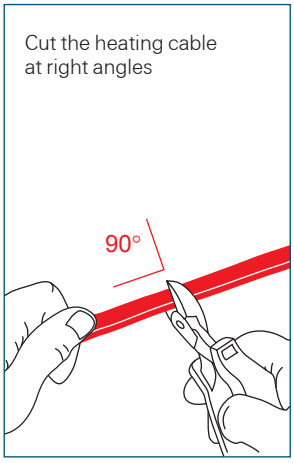
- The heating cable should be installed in a straight line on the pipework.
- Install on dry surfaces
- Minimum installation temperature: −10°C

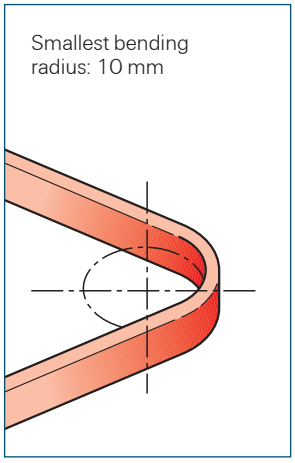


horizontal pipes



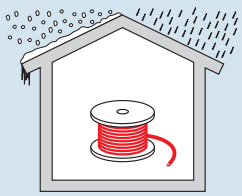






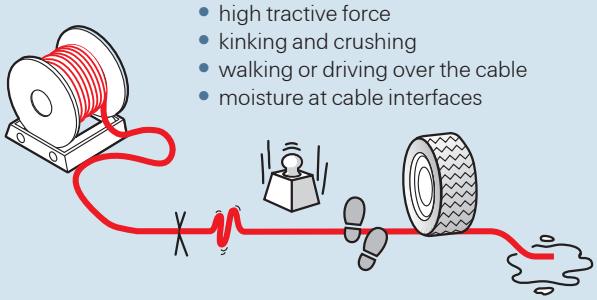
Installation of self-regulating heating cables

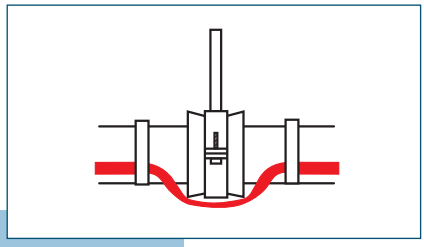
- Store in a dry and clean place.
- Temperature range: −40°C to +60°C.
- Protect any cable ends with an end seal.

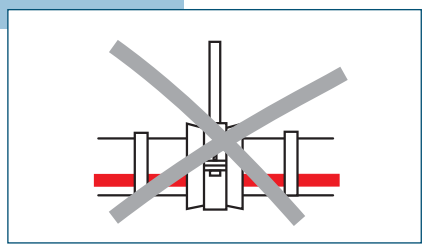


Avoid:

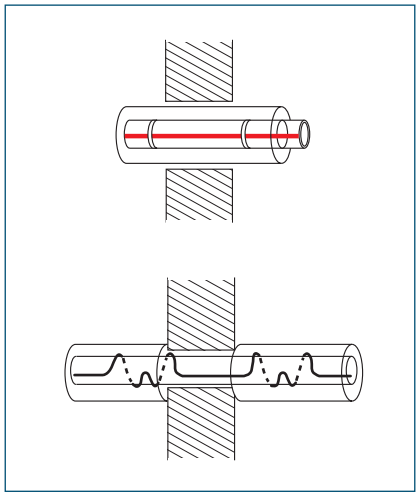
- sharp edges
- high tractive force
- kinking and crushing
- walking or driving over the cable
- moisture at cable interfaces

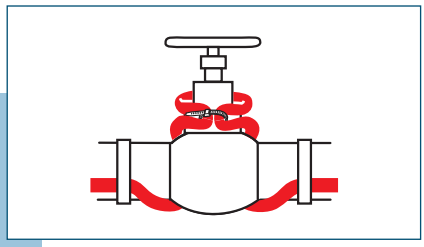






- Run the cable over pipe suspensions
- Do not clamp the cable



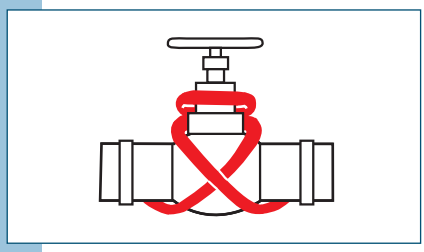


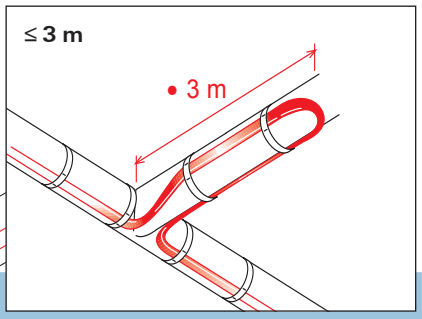
Frost protection at valves:

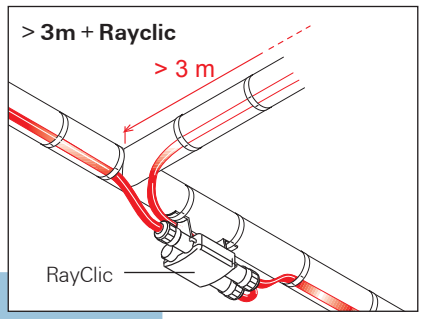
- Valves up to 2″ (DN 50): install the frost protection heating cables in a straight line
- ≥ 2″: lay as shown
- Always insulate valves

Wall/Floor transit

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







FlexiClic™

The fastest connection to frost protection

FlexiClic™ - An innovative, modular approach to frost protection of gutters and pipes!

Raychem FlexiClic provides flexible, reliable, ultra quick and simple to install, self-regulating heat tracing-solutions for energy-efficiency and safe frost protection of pipes.

Increased reliability

- The heating and power cable connections are factory-terminated.
- Checked for additional reliability and peace of mind.

Faster installation

- Design for easy and fast installation.
- Installation times can be reduced by more than 50%. Simply install the heating cable and "click" the modules together.

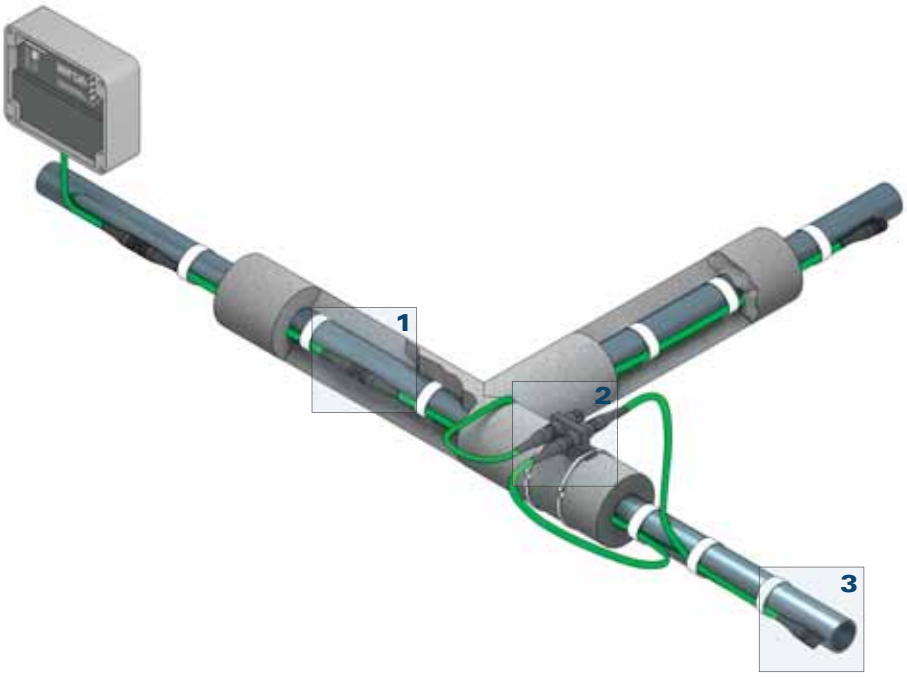
Flexible design

- Easy to extend and configure to match the layout of the pipes or gutters.
- Includes connection devices to provide 3, 4, and 5 way connections for total flexibility.

Modular frost protection for pipes in areas at risk of freezing

System Benefits:

- Heating modules can be easily fixed to the pipe in a straight trace and can be connected in seconds.
- Heating modules are factory-terminated to provide reliable connections every time without the need for cable splicing and termination.
- A heating module can be converted into a T connection by simply installing a connector unit, giving total flexibility in system design.
- The self-regulating heating modules provide energy-efficient frost protection. The system is also compatible with the Raychem AT-TS thermostat range or the Raystat-ECO-10 controller, for further energy savings up to 80%.



How does it work?

Connect power cable to heater

Connect power cable or heating module to connector unit to make T, or 3 output connection

Install an end seal and click in place

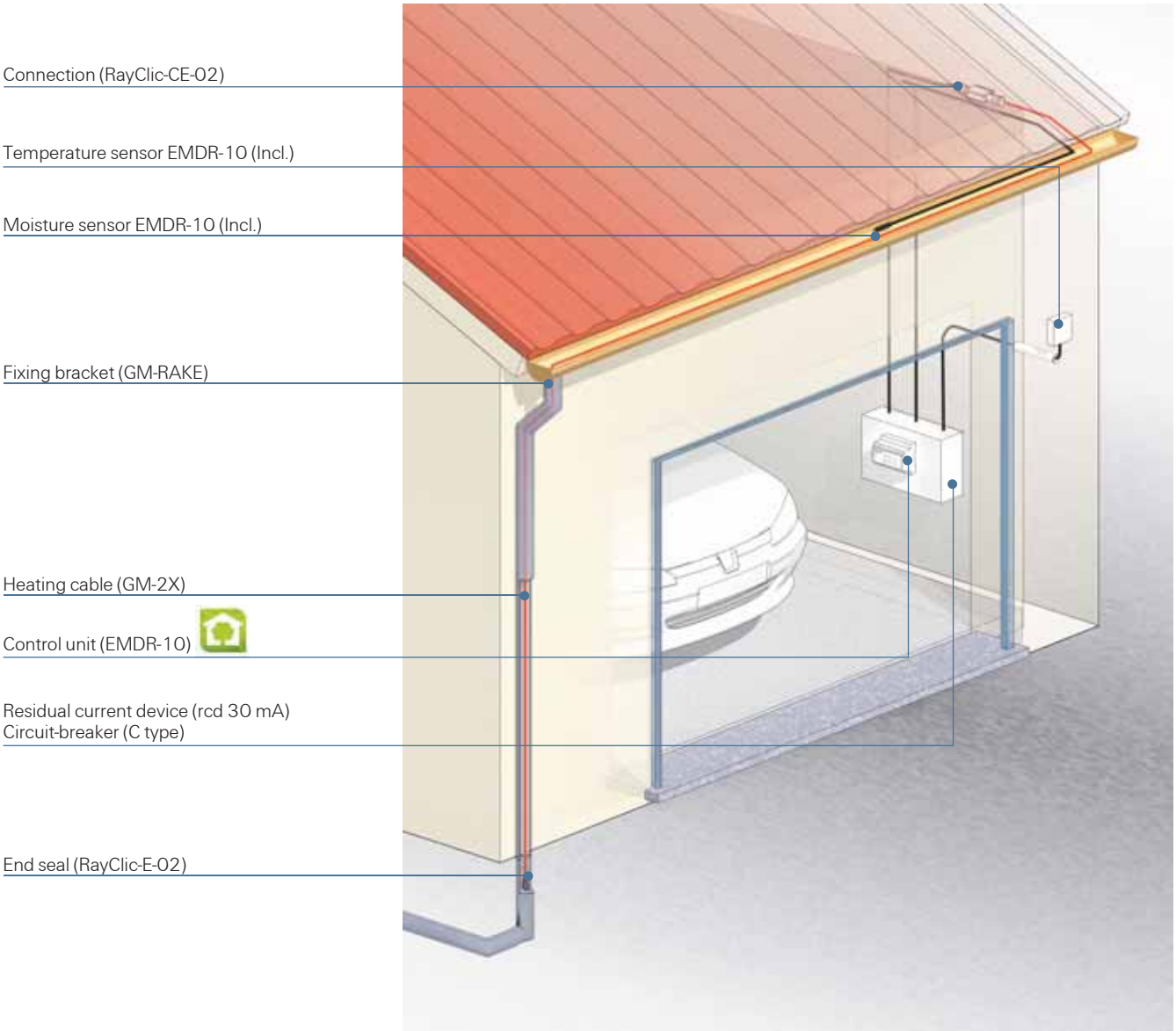
For more information, ask for our design guides: CDE-1275 or our technical data sheet: CDE-1269.
Also visit **www.tycothermal.com**

Frost protection for gutters and downpipes

Melting and refreezing of ice can damage roofs and gutters. Heavy icicles may fall and cause injury. Standing water can leak through interior walls onto furnishings. The Raychem self-regulating snow melting system maintains water flow in gutters and drain pipes and provides a path whereby melting ice and snow can drain safely off the roof, along the gutter and down the drain pipe.

Practical to install
The self-regulating cable can be closely spaced in gutters without the risk for overheating or burn-outs. There is a cable for each type of roof material.

Economical to operate
The self-regulating effect saves energy by automatically increasing its heat output in icy water and decreasing its output in dry air. The smart EMDR-10 control unit only switches the heating cable on when necessary: after the detection of both low temperature and moisture.



Do not install RayClic immersed in water.
Do not bury RayClic in the ground.

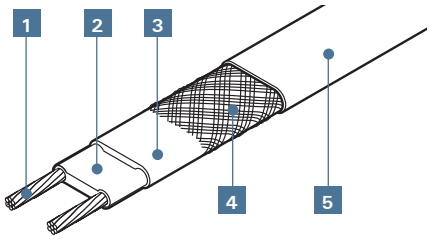
Frost protection for gutters and downpipes

Design guide, control units and accessories

1. Heating cable selection

GM-2X
Self-regulating heating cable for gutters, drain pipes and roof surfaces:
- 36 W/m in iced water and 18 W/m in air at 0°C

2. Composition of the GM-2X heating cable



1. Copper conductor (1.2 mm²)
2. Self-regulating heating element
3. Insulation made of modified polyolefin
4. Tinned copper braid
5. Protective jacket made of modified polyolefin (UV-resistant)

Technical data: see page 58

Important note: When laying cables on asphalt, bitumen, roofing felt, etc., a cable with a special fluoropolymer jacket (8BTV- 2-CT) must be used.

3. Cable length

- The heating cable should be installed in a straight line in the gutter
- The cable lengths should be adjusted according to the geographical situation and the gutters
- More than one cable should be laid in wide valley, parapet or box gutters

Gutter length
+ drainpipe length
+ 1 m per connection
+ 1 m in the soil (frost line)
= required heating cable length

4. Electrical protection

- The length of heating cable determines the number and size of the circuit breakers
- 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 −10°C, 230 VAC.

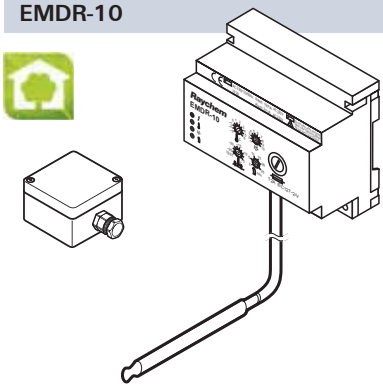
	GM-2X	8BTV-2-CT
6A	25 m	25 m
10 A	40 m	40 m
13 A	50 m	50 m
16 A	60 m	60 m
20 A	80 m	80 m

5. Testing of the installation

See page 55

6. Control units

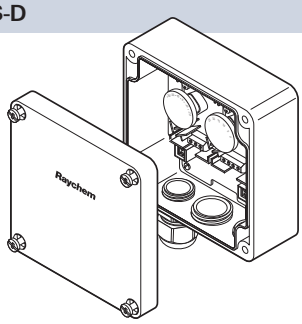
EMDR-10



Smart control unit
- With temperature and moisture sensor
- User-friendly control
- Saves up to 80% energy
- Max. switching capacity 10 A (otherwise switching by contactor)
- Potential free alarm for sensor break age, sensor short and power loss

Technical data: see page 43

HTS-D



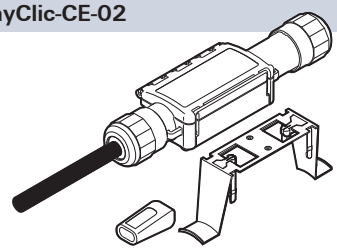
Standard thermostat
- 2 independant switching points
- Max. switching current: 16 A - 250 VAC
- Temperature adjustment range: –20°C to +25°C
- Outdoor installation
- Economical for circuit lengths up to 30 m

Technical data: see page 45

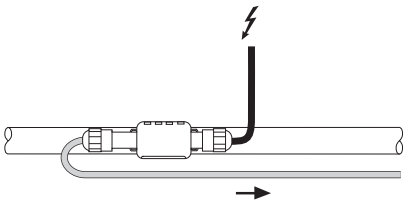
7. Accessories for GM-2X

Avoid installing RayClic in gutters or in places where it may be immersed in water.

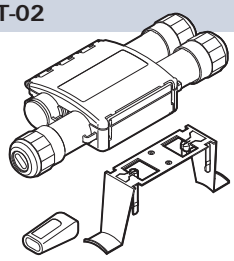
RayClic-CE-02



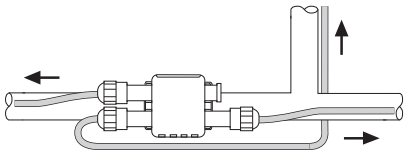
Power connection
- With 1.5 m power cable
- End seal and support bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm



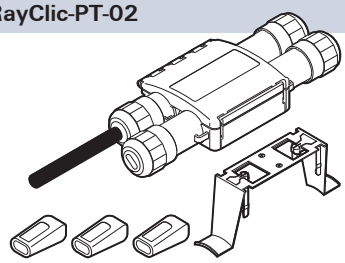
RayClic-T-02



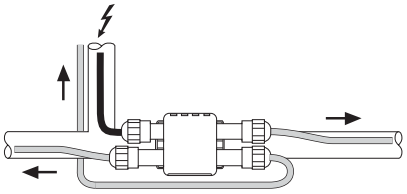
T-connection
- Connection for 3 cables
- 1 end seal and 1 support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42 mm



RayClic-PT-02

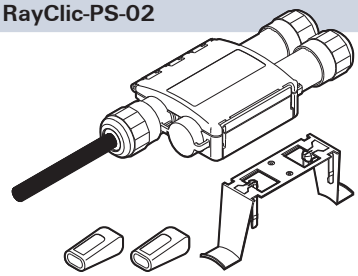


Power T-connection
- Connection for 3 cables with integral 1.5 m power cable
- 3 end seals and 1 support bracket
- IP 68
- External dimension: L = 270 mm
  W = 105 mm
  H = 42mm



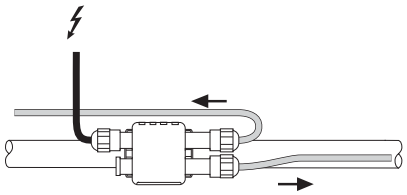
Frost protection for gutters and downpipes

RayClic-PS-02

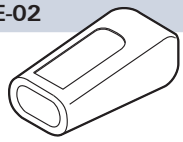


Powered splice

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



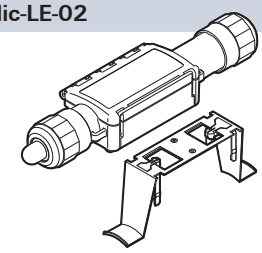
RayClic-E-02



Gel-filled end seal

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

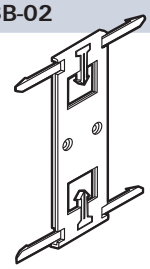
RayClic-LE-02



RayClic with illuminated end seal

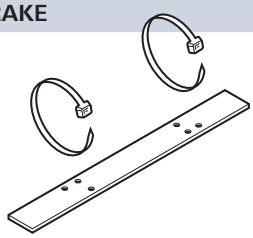
- For visual representation of voltage (by green lamp)
- 1 retaining bracket
- IP 68
- External dimension: L = 240 mm
  W = 64 mm
  H = 47 mm

RayClic-SB-02



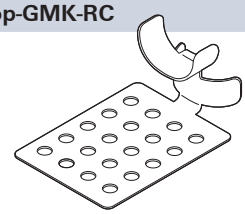
Wall-mounted support bracket

GM-RAKE



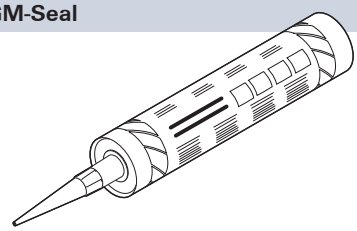
- Fixing bracket/edge protection for drainpipes
- Spacer for use in wide channels or gutters where more than one run of cable is required (a spacer is placed every 100 cm)
- VA steel with UV-resistant cable ties

IceStop-GMK-RC



Roof clip to secure heating cables to roofs and gutters.
Adhesive can be applied on the underside of the roof clip. After curing of the adhesive the heating cable can be clipped between the clamps.

GM-Seal

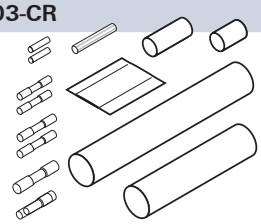


Adhesive for sticking and sealing common construction materials with a base of polyurethane

- 300 ml pack

Do not use GM-seal for adhesion on asphalt, bitumen, roofing or similar surfaces
Contact your Tyco Thermal Controls representative for more information

CCE-03-CR

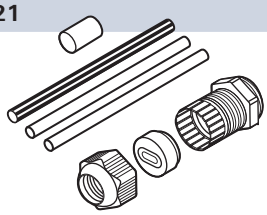


Cold lead connection and end seal kit

- Connection of 3 x 1.5 mm² or 3 x 2.5 mm² cold lead cable to self-regulating heating cable GM-2X

8. Accessories for 8BTV-2-CT heating cable

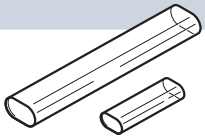
C25-21



Connection kit

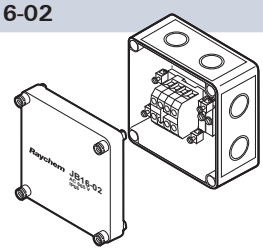
- Heat-schrink technique
- M25 gland

E-06



End Seal kit

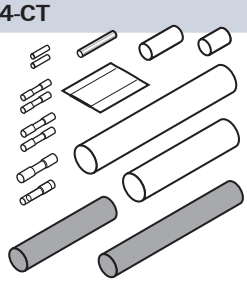
JB-16-02



Junction box

- IP 66
- 6 x 4 mm² terminals
- 4 pg 11/16 and 4 M20/25 knock-out entries

CCE-04-CT



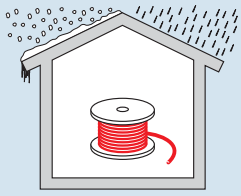
Cold lead connection and end seal kit

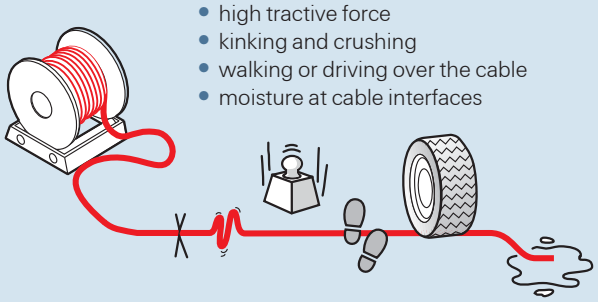
- Connection of 3 x 1.5 mm² or 3 x 2.5 mm² cold lead cable to self-regulating heating cables BTV-2-CT

9. General installation instructions

Installation of self-regulating heating cables

- Store in a dry and clean place.
- Temperature range: –40°C to +60°C.
- Protect any cable ends with an end seal.



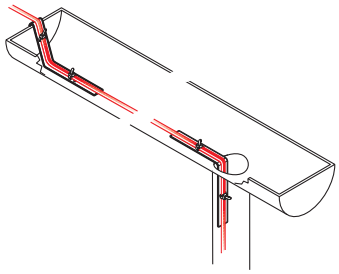


Avoid:

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

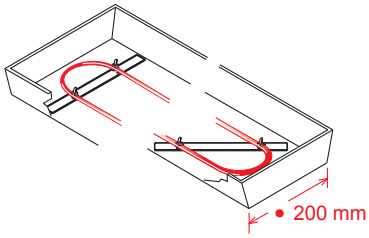
Frost protection for gutters and downpipes

10. Special installation instructions



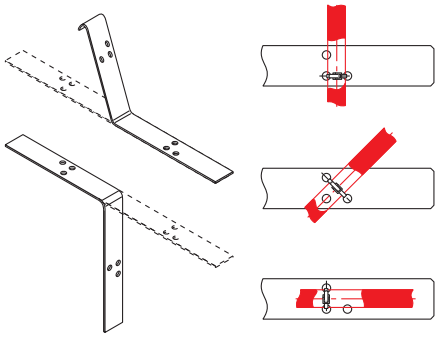
Box gutter < 200 mm

- One heating cable of GM-2X only



Box gutter > 200 mm

- Multiple heating cables of GM-2X
- 2 pc spacer GM-RAKE per meter of gutter edges: GM-RAKE provides mechanical protection against damages



Fastening of the gutter cables

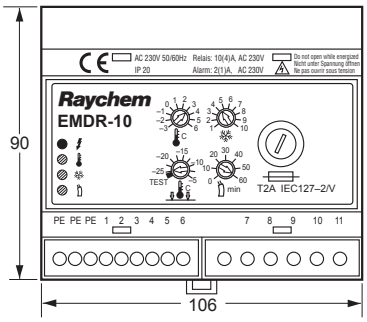
On the roof, eaves bricks, gutter and drainpipe with GM-RAKE edge protection brackets (incl. cable ties).

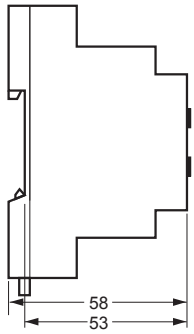
Do not install RayClic immersed in water. Do not bury RayClic in the ground.

In the drainpipe: always install the cable as far as the frost-free area (approx. 1m deep)

Temperature and moisture control unit EMDR-10

Technical data





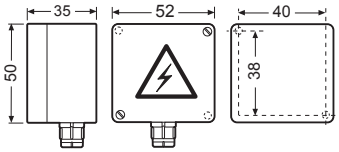
(Dimensions in mm)

Supply voltage	230 VAC, ±10%, 50Hz
Power consumption	max. 4 VA
Max. switching capacity	I_{max} 10(4)A / 230 VAC, SPST, potential 230 VAC
Temperature adjustment range	−3 °C to +6 °C (factory setting +2 °C)
Lower limit temperature adjustment range	test, −25 °C to −5 °C (factory setting −15 °C)
Operating differential	±0.5 K
Measuring accuracy	±1.5 K
Moisture adjustment range	1 (max. sensibility) to 10 (min. sensibility) (factory setting 5)
Post heating time adjustment range	0 to 60 minutes (factory setting 60 minutes)
Alarm relay	I_{max} 2(1)A / 230 VAC, SPDT, potential-free
Moisture sensor (output)	I_{max} 315mA / 230 VAC, with fuse 5 x 20mm T 315mA according to IEC127-2/V
Mounting	DIN rail according to DIN EN 50022-35
Low voltage directive	EN 60730
EMC	EN 50081-1 (emission) and EN 50082-1 (immunity)
Terminals	2.5 mm² (stranded conductors), 4 mm² (solid conductors)
Protection class	II (panel mounted)

Housing

Ambient temperature range	0 °C to +50 °C
Ingress protection	IP20
Housing material	Noryl (self-extinguishing according to UL 94 V-0)
Weight	approx. 350 g

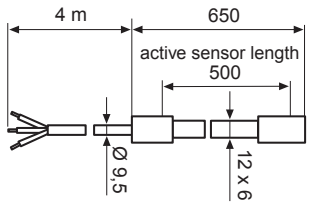
Ambient temperature sensor (VIA-DU-A10)



PG9 (Dimensions in mm)

Sensor type	PTC (FL 103)
Ingress protection	IP54
Terminals	2.5 mm²
Sensor cable	2 x 1.5 mm², max. 100 m (not included)
Exposure temperature	−30 °C to +80 °C
Mounting	Wall mounting

Moisture sensor (HARD-45)



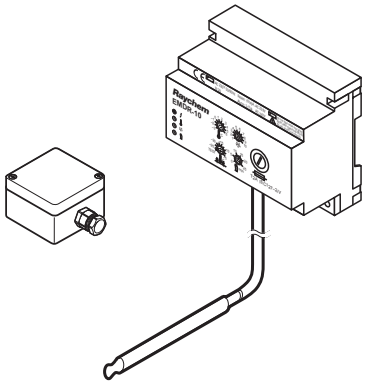
(Dimensions in mm)

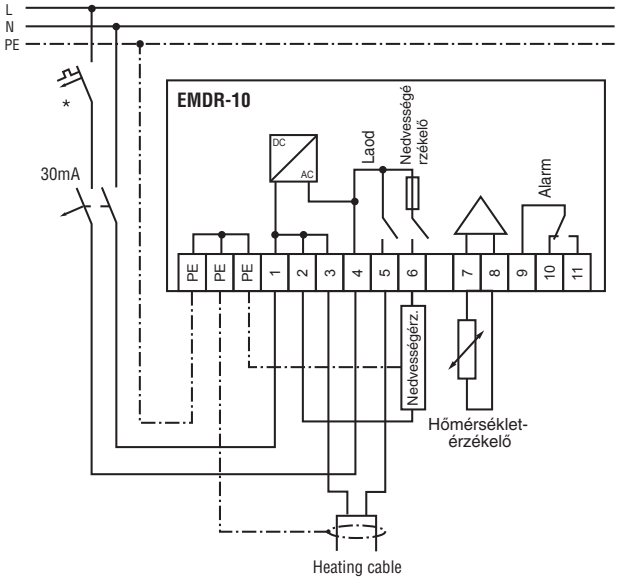
Sensor type	PTC
Power consumption	9 W to 18 W
Ambient temperature range	−30 °C to +65 °C continuous
Supply voltage	230 VAC, ±10%, 50Hz
Connection cable	3 x 1.5 mm², 4 m, the connection cable can be extended to max. 100 m at 3 x 1.5 mm

Frost protection for gutters and downpipes

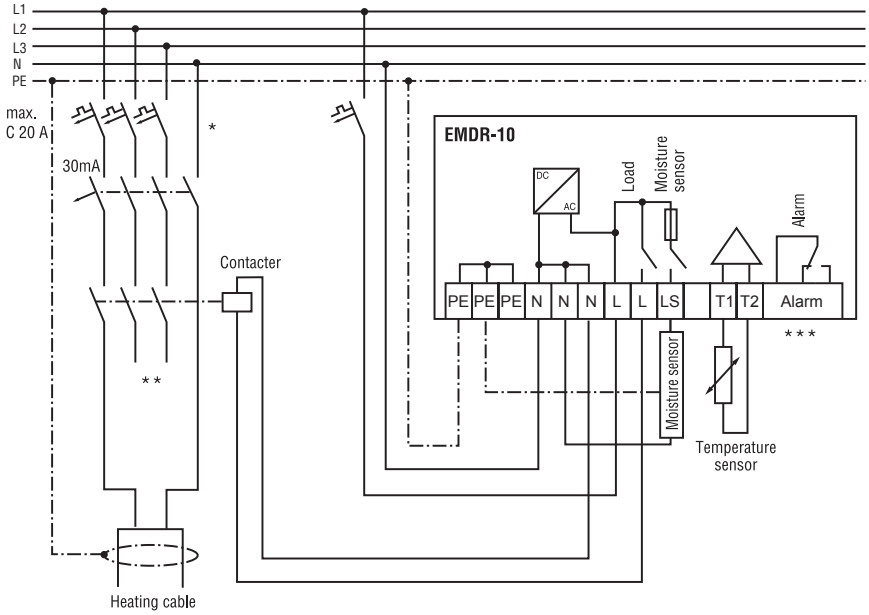
Wiring diagram for EMDR-10

EMDR-10 without contactor





EMDR-10 with contactor



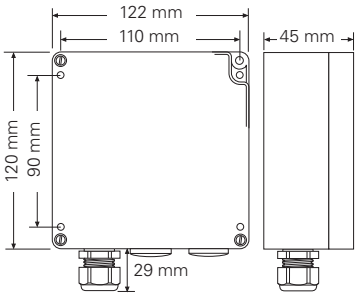
* Two- or four-pole electrical protection by circuit breaker may be needed for local circumstances, standards and regulations

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

*** Potential-free alarm contacts for connection to the BMS

Thermostat HTS-D

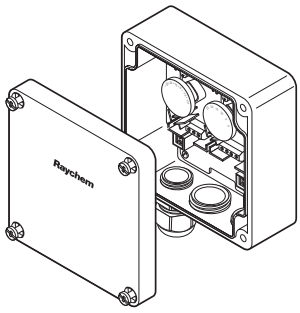
Technical data

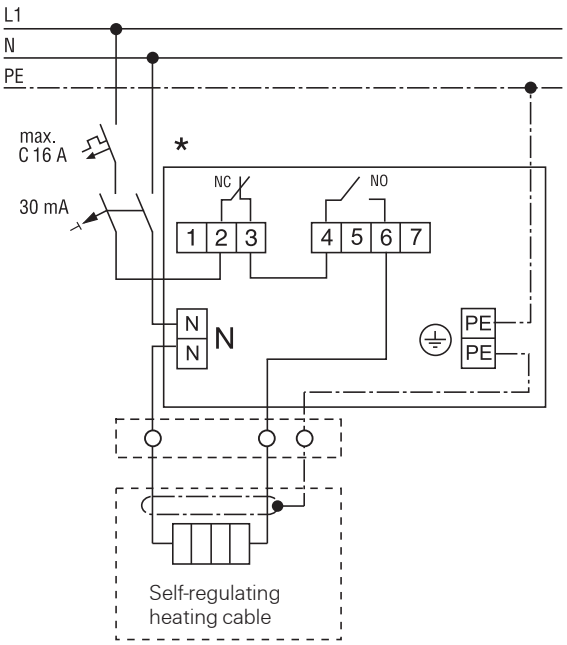


Temperature range	–20°C to +25°C
Operating voltage	AC 230 V, 50 Hz
Max. switch current	16 A / AC 250 V
Max. exposure temperature	50°C
Switch temperature difference	1 K - 3 K
Temperature setting	under the housing cover
Protective system	IP 65

Wiring diagram for HTS-D

HTS-D direct





* Two- or four-pole electrical protection by circuit-breaker may be needed for local circumstances, standards and regulations

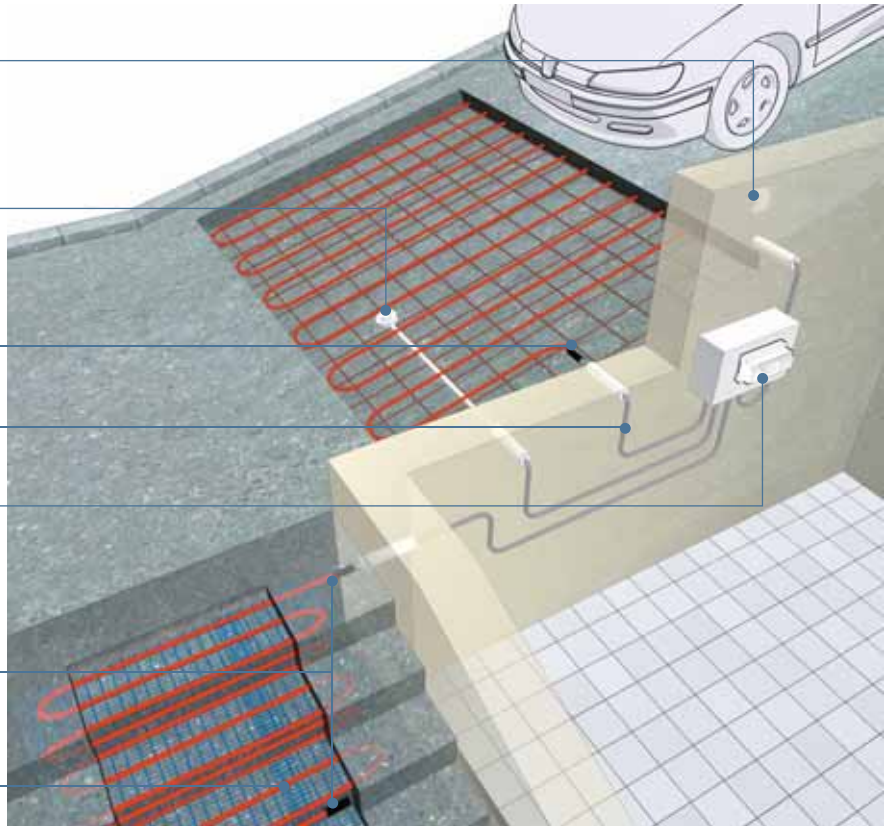
Snow melting for ramps, access ways, and footpaths

Ice and snow on paths, loading bays, driveways, ramps, stairs and other access ways, can present a major problem causing accidents and delays. To help prevent this liability, Raychem provides a complete range of ground heating solutions to prevent snow and ice formation.

The Raychem range of products has been specifically designed to meet the requirements of commercial, industrial, and residential applications. Whether in concrete, sand, or asphalt, a Raychem system exists to provide a fast, reliable, and easy install solution.

Each Raychem heating solution is complete with a Smart control and monitoring unit, providing useful user data and excellent energy efficient performance. The multi-sensor control and monitoring device (VIA-DU-20) is compatible with all ramp snow melting solutions.

Application in concrete

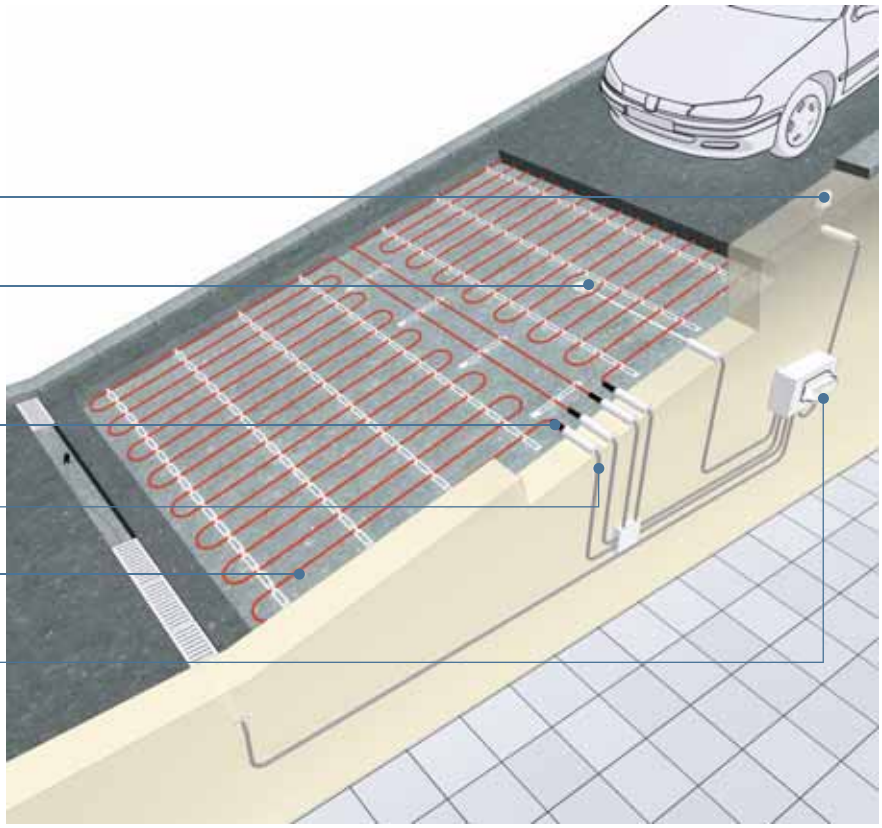


* Optional, only needed when "local detection" is selected.

Raychem Solutions for concrete

	Product	Description
Reinforced concrete surfaces	EM2-XR	Self-Regulating heating cable for reinforced concrete ramps
Domestic and light commercial ground heating applications.	EM2-CM	Pre-terminated constant wattage heating mat for ramp, pavement and track heating
Stairs; wheelchair access ramps	EM4-CW	400V Pre-terminated constant wattage heating cable solution for larger concrete areas and stairs

Application in asphalt



* Optional, only needed when "local detection" is selected.

Raychem Solutions for installation directly below hot-poured asphalt

	Product	Description
Installation in hot asphalt	EM2-MI	Mineral insulated, high temperature resistant heating cable for asphalt ramps

For more information on snow melting products, please refer to document CDE-1540.

Snow melting for ramps, access ways, and footpaths

System overview

Product Features & Selection Guide:

Product Features	EM2-XR	EM2-MI	EM2-CM	EM4-CW
				
Product Description	Self-regulating heating cable	Mineral Insulated constant power heating cable	Constant power polymeric pre-terminated ramp heating mat system	Constant power polymeric pre-terminated heating cable system
Features	Extremely robust self-regulating heating cable for flexible installation under severe site conditions.	Pre-terminated heating cable with exceptional resistance to high temperature asphalt surfaces.	Pre-terminated ramp, walkway, and track heating (Roll-out) mat for fast and simple installation.	Pre-terminated constant power heating cable for larger areas & 400 V power supplies.
Voltage Rating	230 Vac	230 Vac	230 Vac	400 Vac
Nominal power output	90 W/m @ 0°C.	50 W/m	300 W/m^2	25 W/m
Maximum circuit length	85 m	136 m	12.6 m^2 (Mat size = 21 m x 0,60 m)	250 m
Maximum exposure temperature	100°C	250°C	65°C	65°C
Connections & termination	Cut-to-length system for flexible field termination (using Raychem heat-shrink components). Pre-terminated cable lengths (fixed or configured) available. Contact us.	Factory pre-terminated	Factory pre-terminated	Factory pre-terminated
Compatible control unit	VIA-DU-20	VIA-DU-20	VIA-DU-20	VIA-DU-20
Approvals	VDE / CE	VDE / CE	VDE / CE	VDE / CE
Suitable for installation on reinforcement bar	★★★ Highly recommended	★★ Recommended		★★ Recommended
Suitable for installation in direct contact with hot poured asphalt		★★★ Highly recommended		
Suitable for embedding in sand sub-level	★★ Recommended	★★ Recommended	★★★ Highly recommended	★★★ Highly recommended
Cold lead included	Not as standard. Contact Tyco Thermal Controls for information on Configured EM2-XR heating elements.	3 m (at each end of heater cable)	4 m	4 m
Dual Wire / Single Wire construction	Dual	Single	Dual	Dual

Electrical underfloor heating

Comfort is everything, especially in the home. With Raychem's smart electrical underfloor heating, you can offer a beautiful warm floor; hassle free to your customers!

5 good reasons to choose Raychem smart underfloor heating

1. Comfortable and safe
2. Hassle free installation and maintenance free
3. Energy-efficient and cost saving
4. Can be installed under all floor coverings
5. Total care warranty

The Raychem Underfloor heating range comprises:

- **T2Red**: The innovative and unique self- regulating floor heating cable.
- **T2Red** with **T2Reflecta**: The energy-saving underfloor heating system. This system combines the self-regulating heating cable T2Red with T2Reflecta, the grooved, thermally insulated, aluminium-covered plate.
- **T2QuickNet**: The ultra thin heating mat (two power options available).
- **T2Blue**: The robust, flexible, pre-terminated (dual wire, and screened) cable system.
- "Smart" thermostats which offer zoned, programmable heating control, **a requirement of Part L of the building regulations.**
- A complete range of installation accessories and components including:
  - Floor primers
  - Adhesives
  - Fixing accessories
- **CeraPro**: The ultra thin, robust, under tile heating cable solution with „Tape & Mesh" fixing accessories included.

Electrical underfloor heating

Smart services for design and specification

Raychem offers a comprehensive design and specification service for consultants and architects, free of charge.

Using bespoke floor heating design software, we provide:

- Optimised installation plans for the designer and installer in 2 & 3 dimensional views.
- Zone by zone product data including heat output per room and per m^2 in the room.
- Detailed bill of materials, optimised by the software to minimise waste.

With a design proposal complete, we provide specification support to ensure quality procurement.

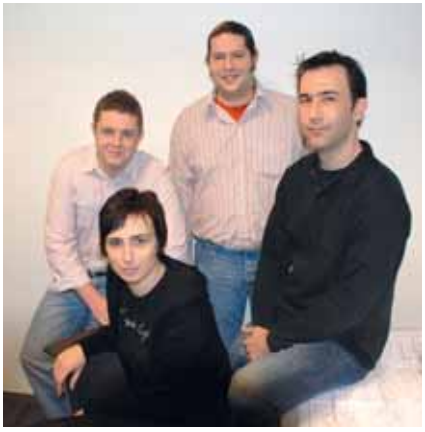
Support tools on the web

Design and specification tools are available at:

www.raychemfloorheating.com

- Energy consumption calculator
- Product selection guide
- A "We design it for you" e-request service.
- Building material selection tool

Local support from an expert team



The Raychem systems and services are supported by a dedicated specifications team. We can provide sound design advice specific to your project needs.

We are also available to:

- Support consultants and architects at early design/concept stage and provide floor heating options.
- Visit the project site to survey the requirements and make recommendations for the consultant, client, and contractor.
- Provide contact details of local suppliers and installers of Raychem floor heating systems.

Safety and reliability

12 Total care warranty

20 Total care warranty

Quality products - installed and checked by a professional electrician - assure home owners the comfort of a warm floor with Total Care. When installing Raychem floor heating systems, electricians can now offer a 12 Year Total Care Warranty to their customers. Certified Pro* installers can extend the Total Care Warranty up to 20 years.

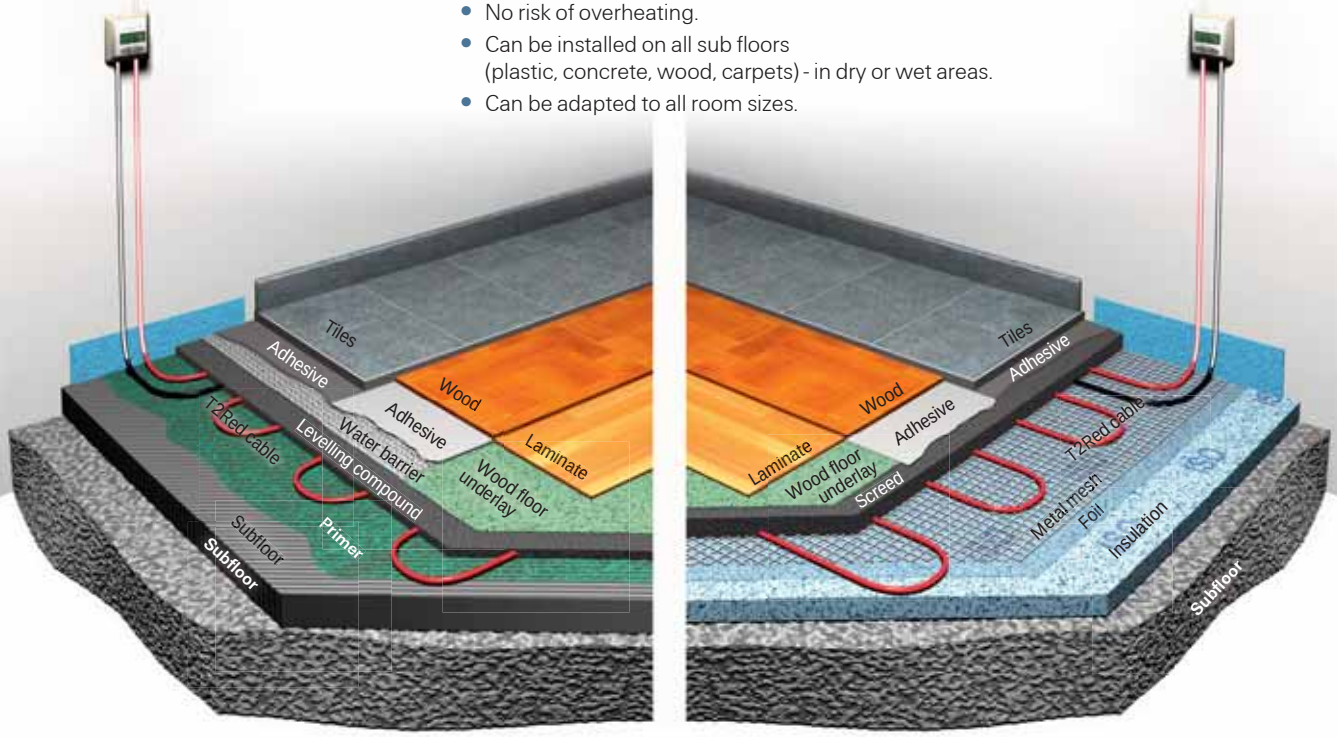
Total Care = doing what it takes to assure a warm floor. In the rare event that our product would fail and we cannot repair it, we will not only provide you with a new product and pay the costs of installing it. We will also take care that the floor covering is repaired or replaced to the equivalent standard.

* For more information: ask for the Floorheating handbook or go to **www.raychemfloorheating.com**

T2Red: the intelligent underfloor heating system

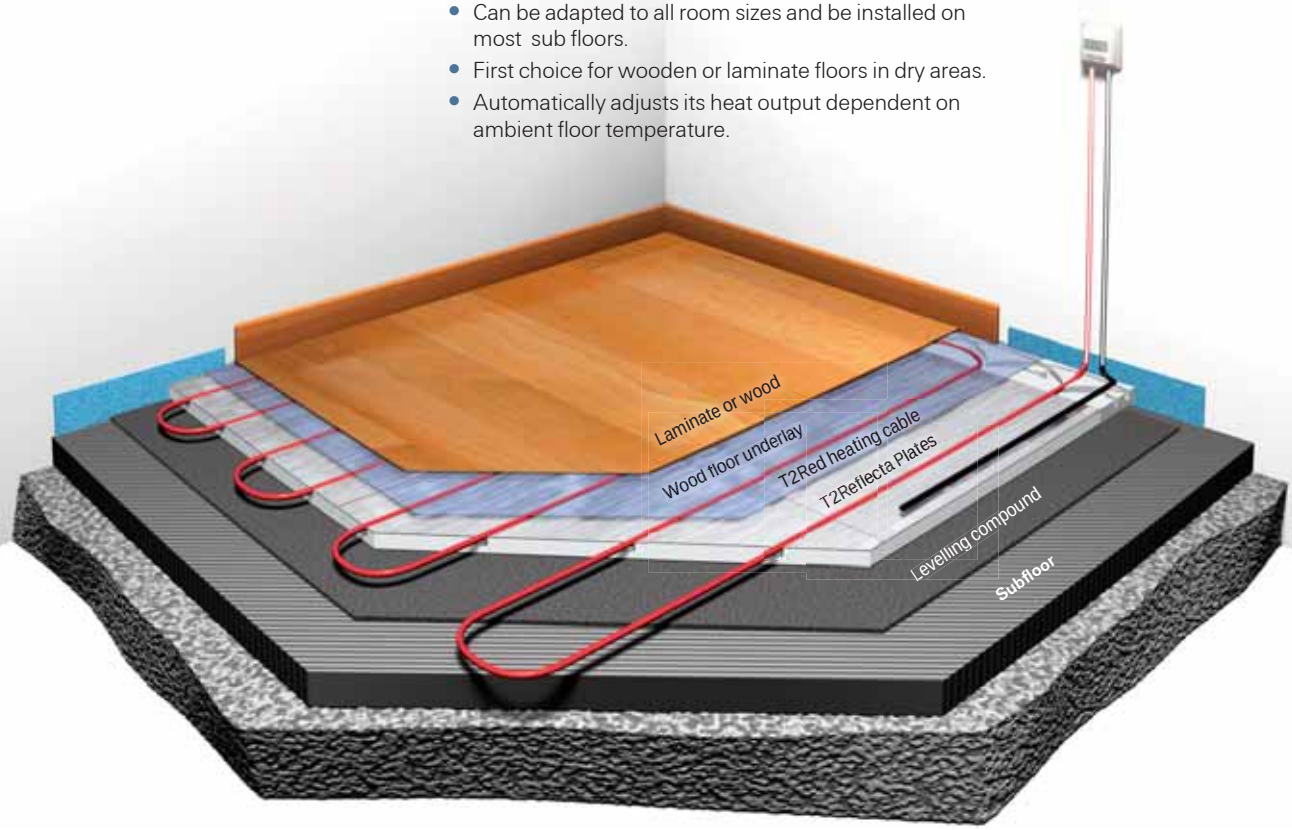
Senses other sources of heat and adjusts its heat output accordingly.

- Makes wet floors dry faster.
- No risk of overheating.
- Can be installed on all sub floors (plastic, concrete, wood, carpets) - in dry or wet areas.
- Can be adapted to all room sizes.



T2Red with T2Reflecta: the energy-efficient solution

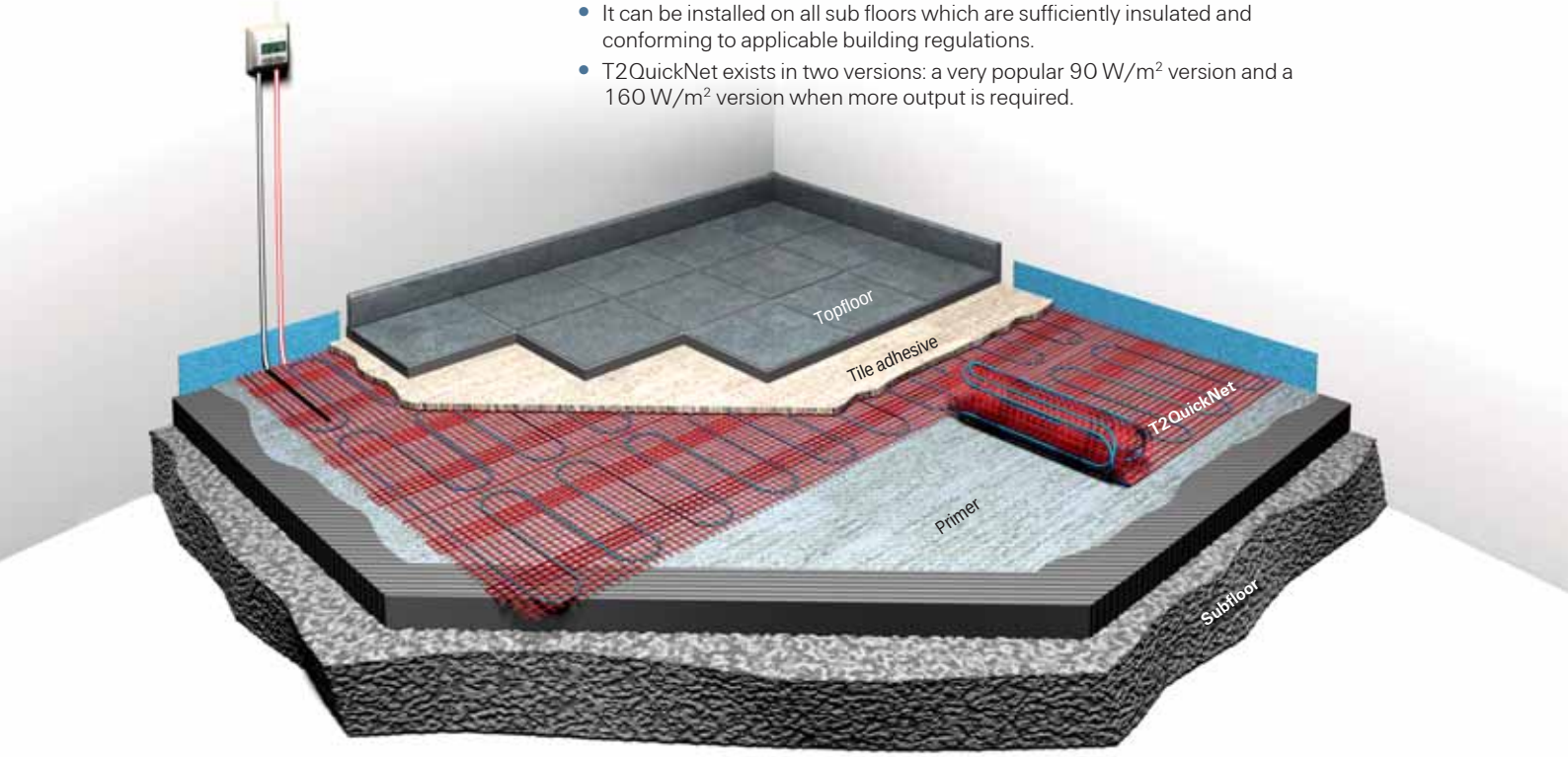
- The T2Reflecta system combines the self-regulating T2Red heating cable with the pre-grooved T2Reflecta; a thermally insulated, aluminium-covered plate.
- Provides extra energy savings of 20% or more
- Can be adapted to all room sizes and be installed on most sub floors.
- First choice for wooden or laminate floors in dry areas.
- Automatically adjusts its heat output dependent on ambient floor temperature.



Electrical underfloor heating

T2QuickNet: the ideal solution for renovation

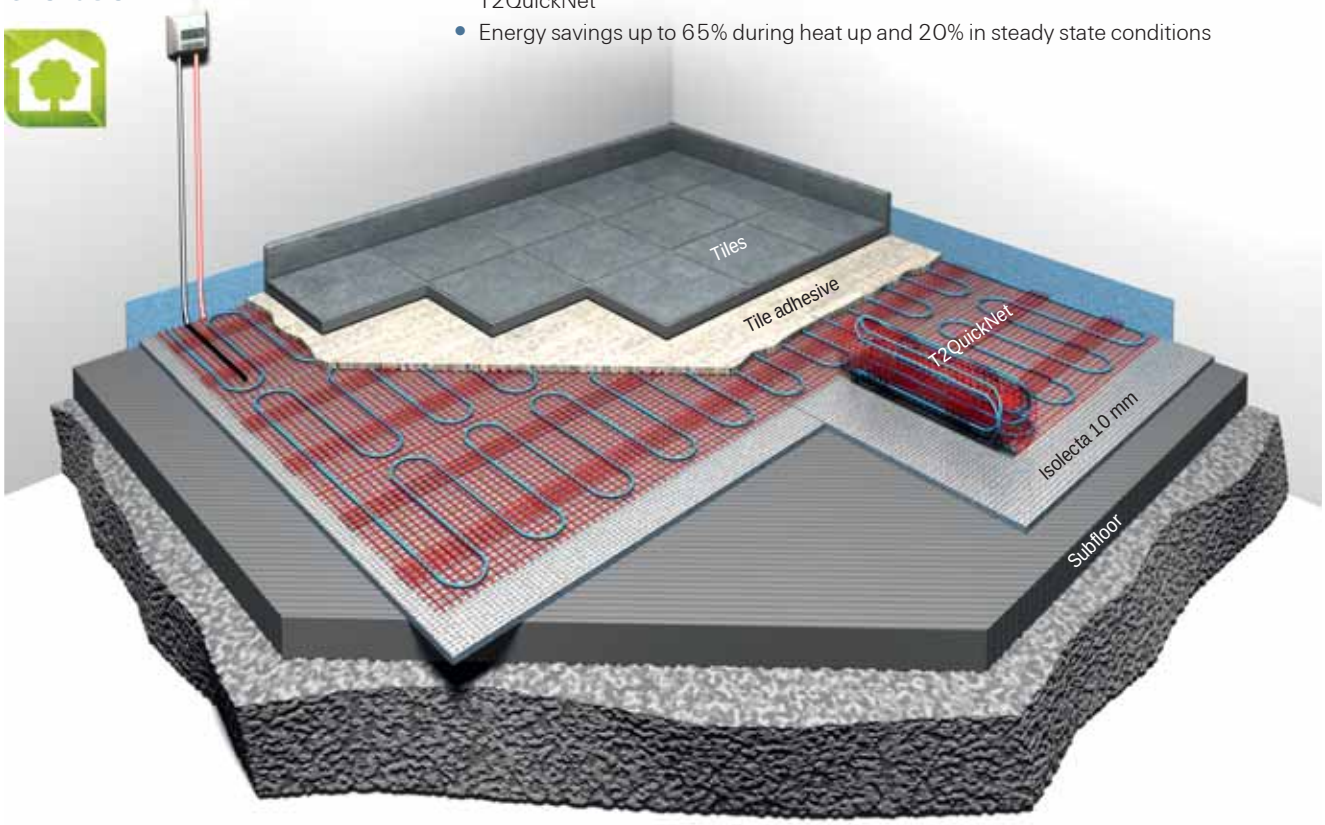
- The thin T2QuickNet mat is the ideal solution for renovation especially for tile floors. The ultra-thin (3 mm) mat is laid directly in the filler.
- It can be installed on all sub floors which are sufficiently insulated and conforming to applicable building regulations.
- T2QuickNet exists in two versions: a very popular 90 W/m^2 version and a 160 W/m^2 version when more output is required.



T2QuickNet + Isolecta Insulation board: the insulated, thin heating mat solution for renovation

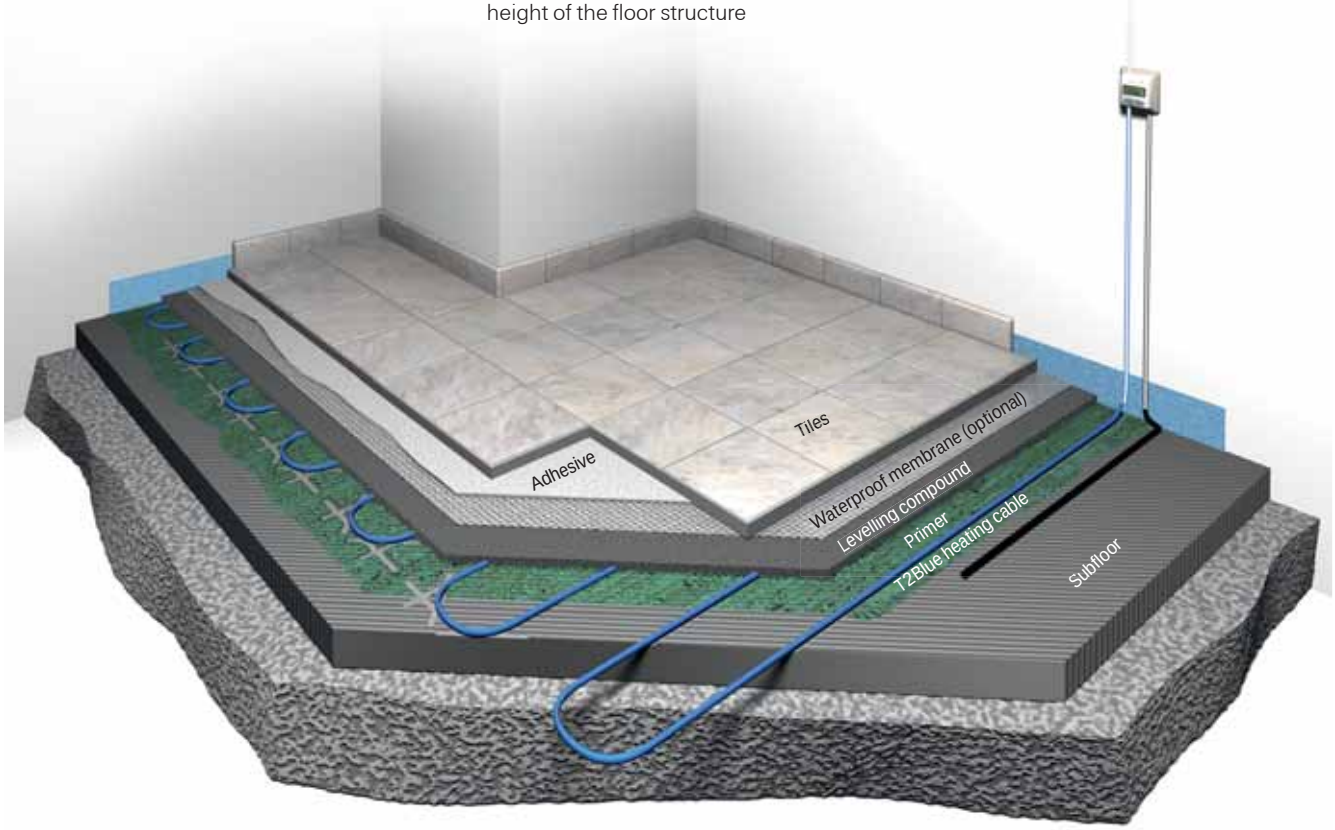
Ideal for renovation projects:

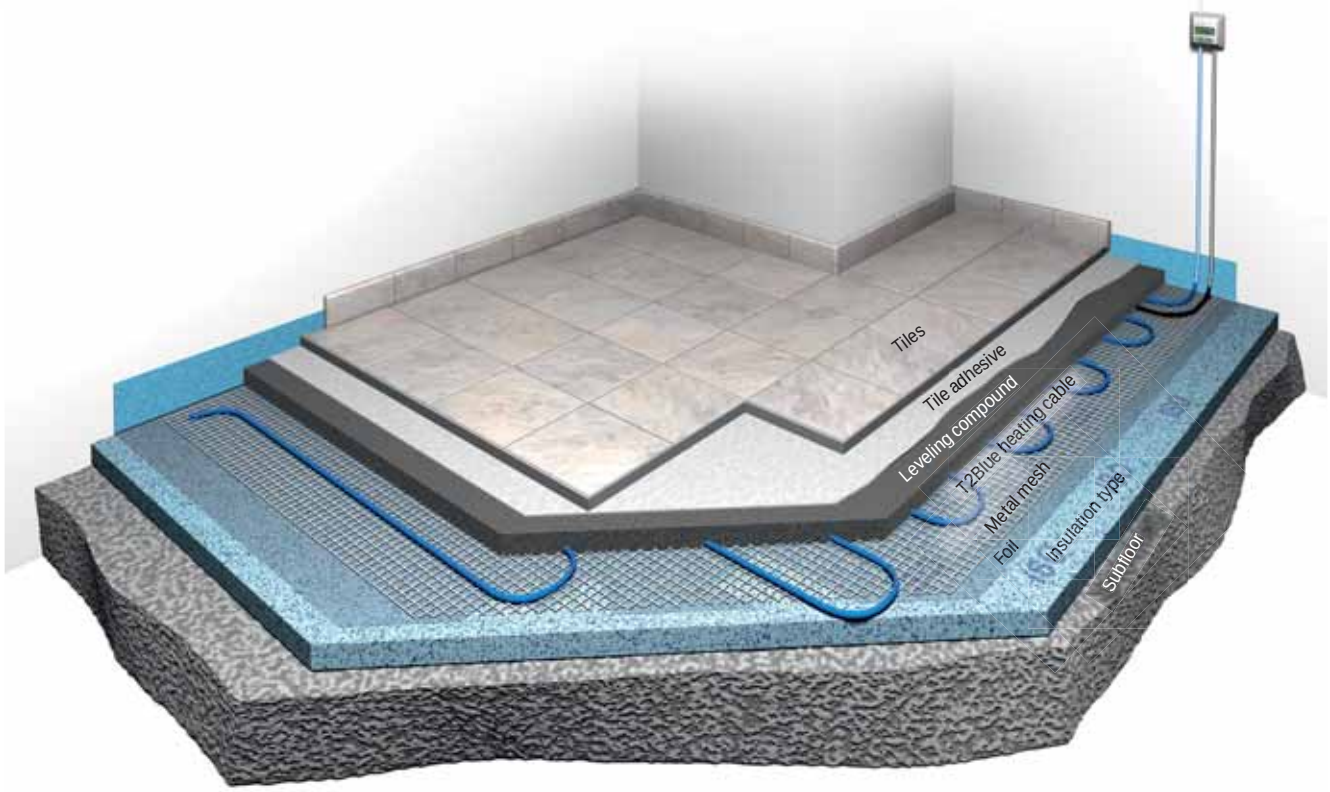
- Extra insulation layer
- Fast heat up: Reducing heat up time by additional insulation layer underneath of T2QuickNet
- Energy savings up to 65% during heat up and 20% in steady state conditions



T2Blue: the flexible underfloor heating cable

- The flexible underfloor heating cable is suitable for installation directly in a levelling compound, screed, or concrete.
- Heating cable with pre-fabricated power connection cable
- Ideal for complex floor layouts.
- Power output flexibility by varying the distance between heating cables.
- Suitable for laying in milled grooves in the screed/concrete without increasing the total height of the floor structure

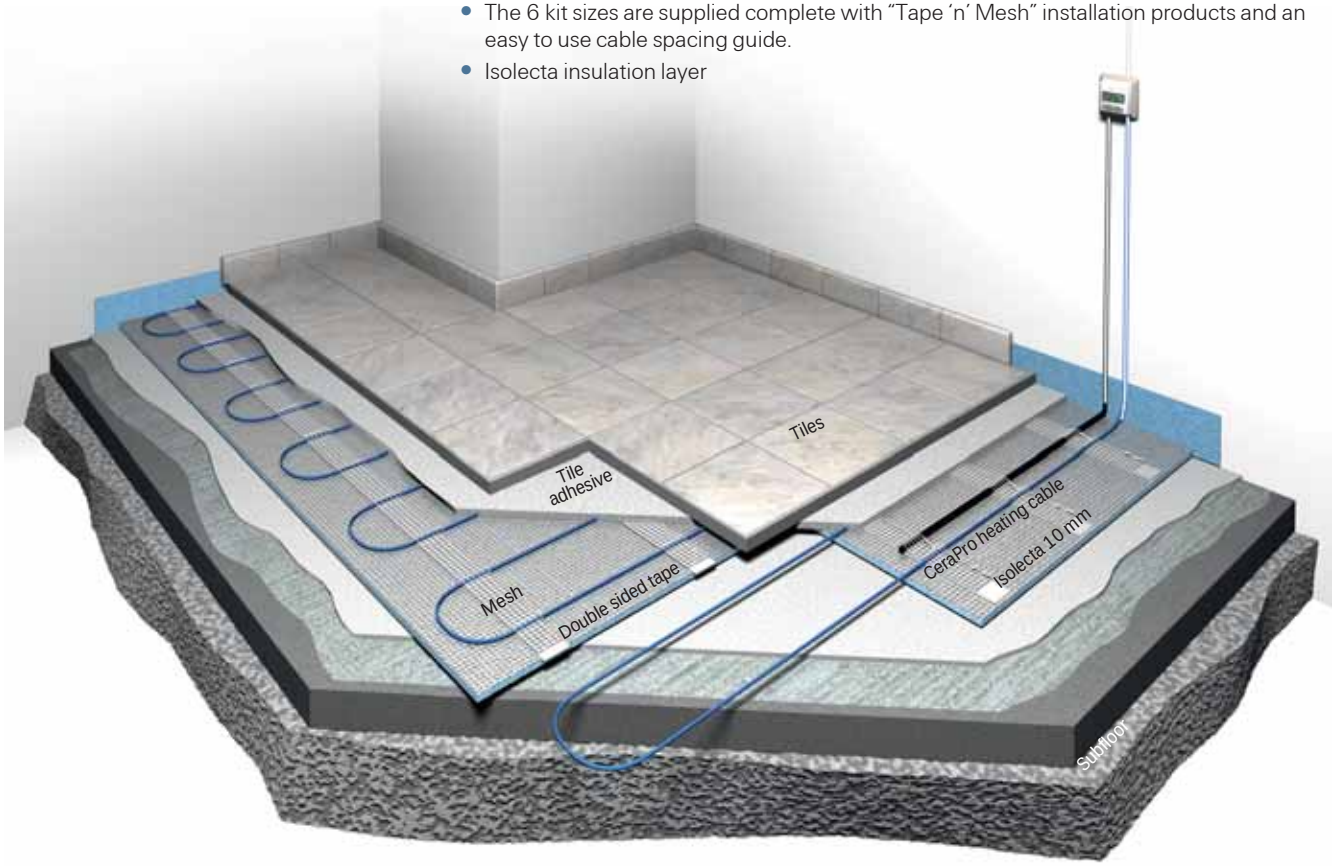




Electrical underfloor heating

CeraPro + Isolecta: the robust, under tile heating cable solution

- The ultra thin, robust heating cable can be installed directly in the tile adhesive without the need for additional screeding over the heater.
- The high grade Fluoropolymer material give high resistance to mechanical damage during installation when compared with market alternatives.
- It can be installed on both wooden and concrete subfloors (maximum installed output of 100 W/m^2 on wooden subfloors.)
- The heater spacing can be adjusted to allow for typical outputs between 100 and 150 W/m^2.
- The 6 kit sizes are supplied complete with "Tape 'n' Mesh" installation products and an easy to use cable spacing guide.
- Isolecta insulation layer



General installation instructions

Checklist for problem-free installation and safe operation

Typical installation schedule for hot water temperature maintenance

General order of events

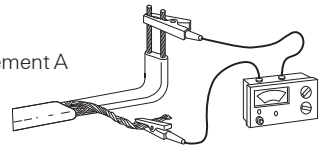
- The system is designed and the installation planned
- The pipework is pressure tested or otherwise checked for leaks
- The HWAT-L/M/R cable is tested and then installed on the designated pipes
- The components are installed and each circuit is tested
- The correct thermal insulation is applied, without 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)

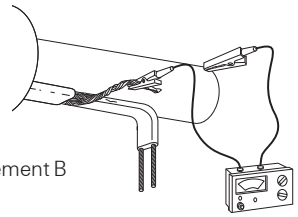
Circuit protection, testing and operation for all systems

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

Measurement A





Measurement B

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 installation times

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

Pipework	
Installation of heating cable on pipes including fastening, standard installation:	25 metres/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

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	Un-twist and install end seal
RCD residual current device trips:	More than 500 m of frost protection heating cable installed per rcd	Install additional rcd residual current device
	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 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. Insulation according to tables in design guides.	Test the mixer tap

Note: Installation and operation information is available from Tyco Thermal Controls in document reference: CDE-1547.

Technical data
Choice of accessories

	Hot water temperature maintenance			Frost protection for pipes				Frost protection for gutters and downpipes			Snow melting for ramps, access ways, and footpaths		
Cable type	**HWAT-L**	**HWAT-M**	**HWAT-R**	**FS-A-2X**	**FS-B-2X**	**FS-C-2X**	**FS-C10-2X**	**GM-2X**	**8BTV-2-CT**	**EM2-XR**	**EM2-MI**	**EM2-CM**	**EM4-CW**
Colour								Matt	Glossy				
Nominal voltage	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	400 VAC
Nominal power output (*on insulated metal pipes)	7 W/m at 45°C	9 W/m at 55°C	12 W/m at 70°C	10 W/m at 5°C	26 W/m at 5°C	31 W/m at 5°C 22 W/m at 40°C	10 W/m at 5°C	36 W/m in ice and 18 W/m in air at 0°C	18 W/m in air at 0°C 36 W/m in ice at 0°C	90 W/m at 0°C	50 W/m	300 W/m^2	25 W/m
C-type circuit-breaker according to selected kit	max. 20 A	max. 20 A	max. 20 A	max. 16 A	max. 16 A	max. 16 A	max. 20 A	max. 20 A	max. 20 A	max. 50 A	max. 20 A	max. 20 A	max. 20 A
Max. circuit length	180 m 20 A	100 m 20 A	100 m 20 A	150 m 16 A	105 m 16 A	90 m 16 A	180 m 20 A	80 m 20 A	80 m 20 A	85 m 50 A	136 m	21 m (12.6 m^2)	250 m
Min. bending radius	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	12,7 mm (at 20°C)	50 mm	50 mm	–	30 mm
Max. continous exposure temperature	65°C	65°C	80°C	65°C	65°C	95°C	90°C	65°C	65°C	100°C	250°C	65°C	65°C
Max. exposure temperature (power-on condition – 800 h. cumulative)	85°C	85°C	90°C	85°C	85°C	95°C	90°C	85°C	85°C	110°C	250°C	65°C	65°C
Max. dimensions in mm (W x H)	13.8 x 6.8	13.7 x 7.6	16.1 x 6.7	13.7 x 6.2	13.7 x 6.2	12.7 x 5.3	16 x 6.8	13.7 x 6.2	16.1 x 6.2	18.9 x 9.5	min 4,8; max. 6,3	5,0 x 7,0	5,0 x 7,0
Weight	0.12 kg/m	0.12 kg/m	0.14 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.14 kg/m	0.13 kg/m	0.13 kg/m	0.27 kg/m	–	–	–
Approvals	BS / ÖVE / VDE / SEV / CSTB / SVGW / DVGW / CE / VDE											CE / VDE	
Control units	QWT-05 HWAT-ECO**	HWAT-ECO**	HWAT-ECO**	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL-10 RAYSTAT-ECO-10** RAYSTAT-CONTROL-11-DIN	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL-10 RAYSTAT-ECO-10** RAYSTAT-CONTROL-11-DIN	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL-10 RAYSTAT-CONTROL-11-DIN	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL-10* RAYSTAT-ECO-10** RAYSTAT-CONTROL-11-DIN	EMDR-10** HTS-D	–	VIA-DU-20**	VIA-DU-20**	VIA-DU-20**	VIA-DU-20**
Connection system													
Junction box	–	–	–	–	–	JB16-02	JB16-02	–	JB16-02	VIA-JB2	VIA-JB-2	VIA-JB-2	VIA-JB-2
Connection kit	RayClic	RayClic	RayClic	RayClic	RayClic	CE20-01	CE20-01	RayClic	CE25-21 E-06	VIA-CE1	Pre-installed		
Support bracket	included in the kit	included in the kit	included in the kit	included in the kit	included in the kit	JB-SB-08	JB-SB-08	included in the kit	JB-SB-08	–	–	–	–

Approvals: BS/VDE/ÖVE/ERFA/CE

* For max circuit, Raystat controller will be required. **

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Tyco Thermal Controls is also a proud industry supporter offering approved CPD courses via the Chartered Institute of Building Services Engineers. Courses include technical and application information for electrical underfloor heating and hot water temperature maintenance systems.

For further information, please consult the CIBSE Course Directory 2010 or contact Tyco Thermal Controls.

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