Designing hydronic floor heating
Get the optimum results

7 applications to help you design and install Danfoss floor heating systems.
THE RIGHT PRODUCTS FOR YOUR APPLICATION

Choosing the right products not only depends on the application. Once you have identified the product groups relevant for your application, simply go to the Product Guide brochure to narrow down the choice to specific product codes.

This application guide:
• Recommends specific product groups for different applications
• Recommends which pipe layout pattern to use in different situations
• Shows the benefits and impact of using cement and liquid screed
Application guides for manifolds and controls

FLOOR HEATING SYSTEM WITH INDIVIDUAL ROOM CONTROL, LOW TEMPERATURE

FLOOR HEATING SYSTEM WITH INDIVIDUAL ROOM CONTROL, HIGH TEMPERATURE

MIXED SYSTEM WITH INDIVIDUAL ROOM CONTROL, HIGH TEMPERATURE

FLOOR HEATING SYSTEM WITH REFERENCE ROOM CONTROL, LOW TEMPERATURE

MIXED SYSTEM WITH SELF-ACTING ROOM CONTROL

FLOOR HEATING SYSTEM WITH INDIVIDUAL ROOM CONTROL, LOW TEMPERATURE AND COOLING IN 2-PIPE SYSTEM

FLOOR HEATING SYSTEM WITH INDIVIDUAL ROOM CONTROL, LOW TEMPERATURE AND COOLING IN 3/4-PIPE SYSTEM

How to design effective pipe layout

MEANDER PATTERN VS. SNAIL PATTERN

SMALL WINDOWS VS. LARGE WINDOWS

BATHROOM AND KITCHEN LAYING PATTERNS AND DISTANCE

LARGE ROOMS LAYING PATTERNS AND DISTANCE

Choosing the right floor screed

LIQUID SCREED VS. CEMENT SCREED
Balancing valves

Manifold with control valves for actuators

Manifold without control valves for actuators

Mixing shunt

Room thermostat generic

Room thermostat wired

RA-HC with actuator TWA

FHV self-acting thermostatic valve

Connection box

ECL weather compensator

ESM-11 pipe sensor for supply pipe for automatic change over between cooling and heating in 2-pipe system or dew point sensor in 3/4 pipe systems
Where to use:

- 1 and 2 family houses
- Multi family houses
- Light commercial buildings

Advantages:

- Individual room comfort and energy savings achieved by room thermostats
- Energy savings on heat production and pump energy with connection box relays
- Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting

Components suitable for application:

<table>
<thead>
<tr>
<th>Controls</th>
<th>Danfoss Link™</th>
<th>CF2⁺</th>
<th>FH-Wx</th>
<th>Danfoss Icon™</th>
<th>BacisPlus²</th>
<th>FHV</th>
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<tbody>
<tr>
<td>Manifolds</td>
<td>FHF-F</td>
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<td>AB-PM</td>
<td>ASV-PV + ASV-BD</td>
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</table>

Complementary products suitable for application:

- Mixing shunts are not needed in low supply temperature applications.

* Danfoss Icon™ and BasicPlus² can be combined with connection box to achieve energy savings on heat production and pump energy with relays.
Floor heating system with individual room control

guide

high temperature

Where to use:

1 and 2 family houses
Multi family houses
Light commercial buildings

Advantages:

• Individual room comfort and energy savings achieved by room thermostats
• Energy savings on heat production and pump energy with connection box relays
• Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting

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Manifolds

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Balancing valve

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Complementary products suitable for application:

• Mixing shunts to be used in applications with high supply temperatures.
• Use ECL to allow for weather compensated supply temperatures.

* Danfoss Icon™ and BasicPlus² can be combined with connection box to achieve energy savings on heat production and pump energy with relays.
Mixed system with individual room control
high temperature

Where to use:
- 1 and 2 family houses
- Multi family houses
- Light commercial buildings

Advantages:
- Individual room comfort and energy savings achieved by room thermostats
- Energy savings on heat production and pump energy with connection box relays
- Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting

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| Balancing valve | AB-PM | ASV-PV + ASV-BD | Yes | Yes |

Complementary products suitable for application:
- Mixing shunts to be used in mixed systems where there is a need to differentiate the supply temperature in part of the system e.g. radiator system with high supply temperature and floor heating with low temperature.
- Use ECL to allow for weather compensated supply temperatures.

* Danfoss Icon™ and BasicPlus² can be combined with connection box to achieve energy savings on heat production and pump energy with relays.
Floor heating system with reference room control
low temperature

Where to use:
- 1 and 2 family houses
- Multi family houses
- Light commercial buildings

Advantages:
- Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting

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<td>RA-HC</td>
<td>✓</td>
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Complementary products suitable for application:
* Use manifolds FHF, FHF-F and SSM-F for easier flow setting.
** Rough pre-setting with Allen key.
Mixed system with self-acting room control

Where to use:
- 1 and 2 family houses
- Multi family houses

Advantages:
- Individual room comfort and energy savings achieved by room thermostats

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Complementary products suitable for application:
- In case of multi family houses, balancing valve AB-QM should be used.
Floor heating system with individual room control
low temperature and cooling in 2-pipe system

Where to use:
- 1 and 2 family houses
- Multi family houses
- Light commercial buildings

Advantages:
- Individual room comfort and energy savings achieved by room thermostats
- Energy savings on heat production and pump energy with connection box relays
- Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting
- Use floor heating system for passive cooling

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Required products for application:
- ESM-11 pipe sensor for automatic change over between cooling and heating based on supply pipe temperature (CF2+ only).
- Remote controller CF-RC for configuration of system with ESM-11 pipe sensor (CF2+ only).
- To use dew point sensor CF-DS a separate 24V power supply is required (CF2+ only).

* Automatic or manual change over between cooling and heating.
Floor heating system with individual room control
low temperature and cooling in 3/4-pipe system

Where to use:
- 1 and 2 family houses
- Multi family houses
- Light commercial buildings

Advantages:
- Individual room comfort and energy savings achieved by room thermostats
- Energy savings on heat production and pump energy with connection box relays
- Ensure correct flow to heating system on apartment level with balancing valves and manifold flow setting
- Use floor heating system for passive cooling

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Required products for application:
- Remote controller CF-RC for configuration of system.
- Dew point sensor CF-DS.

* Only if differential pressure in the system is <1 bar. If differential pressure is higher please contact Danfoss.
Easier application specification

Online

Our online QuickPlanner dimensioning program enables you to calculate the correct pre-setting values in just minutes. Go online and have the following information ready:

• Room sizes
• Heat requirement (W/m²)
• Supply temperature
• Desired room temperature
• Floor type

→ quickplanner.danfoss.com
HOW TO DESIGN EFFECTIVE PIPE LAYOUT

Application guidelines for heating circuit layout.

The application guidelines provide you with basic application ideas and recommendations on how to design effective layout patterns for different rooms.
Meander pattern

- The meander pattern is easy to lay
- BasicRail™, BasicClip™ and BasicGrip™ systems can be used
- The meander pattern will distribute heating less uniformly across the room. In effect, some parts of the floor will be warmer than others

Snail pattern

- Heating is equally distributed as supply and return water runs adjacent. This provides comfort compared to the meander pattern.
- Requires more planning to lay
- Difficult to use BasicRail™

Pipe distance independent of pattern type example:

<table>
<thead>
<tr>
<th>Floor type:</th>
<th>Wooden floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat requirement:</td>
<td>40 W/m²</td>
</tr>
<tr>
<td>Mean water temp.:</td>
<td>35 °C</td>
</tr>
<tr>
<td>Room temperature:</td>
<td>20 °C</td>
</tr>
<tr>
<td>= Pipe distance</td>
<td>200 mm CC</td>
</tr>
</tbody>
</table>

For information about your specific building, please consult Danfoss.
Small or no windows

Smaller windows do not need to be taken into account as the downdraft is limited.

Example:

| Floor type:       | Tile floor
|-------------------|----------------------
| Heat requirement: | 40 W/m²
| Mean water temp.: | 35 °C
| Room temperature: | 20 °C

= Pipe distance 200 mm CC

For information about your specific building, please consult Danfoss.

Large floor-to-ceiling window

At larger windows the pipe distance must be reduced in order to account for downdraft from the windows.

Example:

| Floor type:       | Tile floor
|-------------------|----------------------
| Heat requirement: | 92 W/m²
| Mean water temp.: | 35 °C
| Room temperature: | 20 °C

= Pipe distance, window 120 mm CC
= Pipe distance, rest 200 mm CC

For information about your specific building, please consult Danfoss.
**Bathroom**

Suggested snail pattern for a typical bathroom. Due to the requirement for higher temperatures in the bathroom, the pipe distance should be reduced.

**Example:**

- **Floor type:** Tile floor
- **Heat requirement:** 67 W/m² (at the window)
- **Mean water temp.:** 35 °C
- **Room temperature:** 24 °C

= **Pipe distance, window** 120 mm CC

For information about your specific building, please consult Danfoss.

**Kitchen**

Avoid placing pipes under the kitchen cabinets. If pipes are placed under the kitchen cabinets, the temperature in the cabinets will increase which is not optimal if they contain food.

**Example:**

- **Floor type:** Wooden floor
- **Heat requirement:** 40 W/m²
- **Mean water temp.:** 35 °C
- **Room temperature:** 20 °C

= **Pipe distance** 200 mm CC

For information about your specific building, please consult Danfoss.
Large rooms

Laying patterns and distance

Suggested snail pattern for a typical large room. Due to the size of the room the number of circuits must be increased (in this example to three circuits).

Example:

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<tr>
<td><strong>Number of circuits</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td>= Pipe distance, window</td>
<td>120 mm CC</td>
</tr>
<tr>
<td>= Pipe distance, rest</td>
<td>200 mm CC</td>
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</table>

For information about your specific building, please consult Danfoss.
CHOOSING THE RIGHT FLOOR SCREED

Application guidelines for floor build-up.

Liquid and cement screed both ensure a smooth and even surface. However, the two types of screed each have different benefits and impact on floor thickness and weight.
Liquid screed vs. cement screed

Benefits and impact

Liquid screed

- Floor thickness reduced compared to cement screed
- Floor weight reduced compared to cement screed
- Reducing thickness and weight can be important in e.g. renovations

- Liquid screed is often more expensive

<table>
<thead>
<tr>
<th></th>
<th>Liquid*</th>
<th>Cement</th>
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<tbody>
<tr>
<td>Screed thickness [mm]</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Insulation thickness [mm]</td>
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<tr>
<td>Construction height [mm]</td>
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<tr>
<td>Weight [Kg/m²]</td>
<td>140</td>
<td>176</td>
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<tr>
<td>Thermal resistance (R) [m²K/W]</td>
<td>0.87</td>
<td>0.87</td>
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<tr>
<td>Thermal transmission coefficient (U) [W/m²K]</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Distribution load [kN/mm²]</td>
<td>&lt;2.0</td>
<td>&lt;2.0</td>
</tr>
<tr>
<td>Point load (&gt;20 cm²) [kN]</td>
<td>&lt;2.0</td>
<td>&lt;2.0</td>
</tr>
<tr>
<td>Impact subsonic noise reduction [dB]</td>
<td>28</td>
<td>28</td>
</tr>
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</table>

* Example based on cement screed with CAF F5 additive. Using other CAF additives will impact thickness and weight.

Carpet / tiles / parquet

Perimeter insulation

FH composite / FH PE-RT pipe (16 mm)

Panel with insulation

Screed
Pioneering heating controls for decades

Danfoss has been designing and developing heating control systems for more than 80 years. Throughout that time, it has been our goal to continuously innovate, perfect and refine cutting-edge heating and cooling solutions.