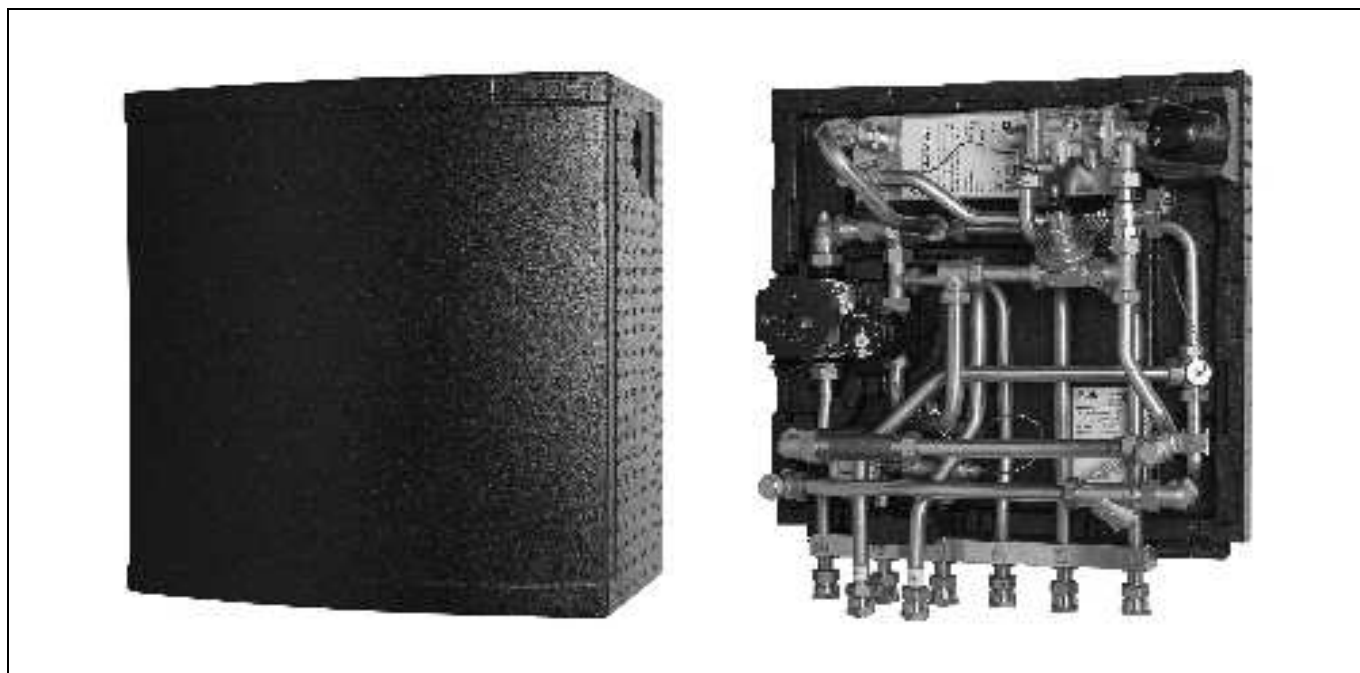


Operating Guide

Termix VMTD MIX-I with complete insulation



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2.0 Functional description

District heating substation for direct heating and instantaneous domestic hot water with thermostatic control. Designed for wall-mounting.

Application

The Termix VMTD MIX-I is a complete solution with built-in water heater and heating system with differential pressure control and mixing loop. The Termix VMTD MIX-I is applicable for single-family houses and for decentralized systems in multi-family houses.

District heating (DH)

The substation is prefabricated with a differential pressure controller, fitting piece and sensor pocket for insertion of a heat meter as well as strainer and ball valves. Furthermore the substation is delivered with a mixing loop including pump, controls and non-return valve.

Heating (HE)

The heating circuit is designed for direct connection. The differential pressure controller sets the optimum operation conditions for radiator thermostats in order to enable individual temperature control in each room. The mixing loop creates a suitable temperature level e.g. for floor heating. In order to enable a time-dependent temperature control program, a zone valve with actuator and a room thermostat can be included as an option.

Domestic hot water (DHW)

The domestic hot water is prepared in the heat exchanger and the temperature is regulated with a flow compensated temperature controller with integrated differential pressure controller. The heat exchanger cools out the DH water very efficiently, thereby creating an excellent operating economy. The Danfoss IHPT valve ensures a stable hot water temperature by varying loads, supply temperatures and by high and varying differential pressure without the need for readjusting the valve. This protects the heat exchanger against overheating and lime scale formation. Furthermore the IHPT valve has an integrated idle temperature controller, which keeps the house supply line warm. This shortens the waiting periods during summer when the heating system is in reduced operation, which is ideal where high comfort is requested.

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3.0 Safety notes

3.1 Safety Notes – general

The following instructions refer to the standard design of substation. Special versions of substations are available on request.

This operating manual should be read carefully before installation and start-up of the substation. The manufacturer accepts no liability for damage or faults that result from non-compliance with the operating manual. Please read and follow all the instructions carefully to prevent accidents, injury and damage to property. Assembly, start-up and maintenance work must be performed by qualified and authorized personnel only. Please comply with the instructions issued by the system manufacturer or system operator.

Corrosion protection

All pipes and components are made of stainless steel and brass. The maximum chloride compounds of the flow medium should not be higher than 150 mg/l. The risk of equipment corrosion increases considerably if the recommended level of permissible chloride compounds is exceeded.

Energy source

The substation is designed for district heating as the primary source of energy. However, also other energy sources can be used where the operating conditions allow it and always are comparable to district heating.

Application

The substation is designed to be connected to the house installation in a frost-free room, where the temperature does not exceed 50 °C and the humidity does not exceed 60%. Do not cover or wall up the substation or in any other way block the entrance to the station.

Choice of material

Choice of materials always in compliance with local legislation.

Safety valve(s)

We recommend mounting of safety valve(s), however, always in compliance with local regulations.

Connection

The substation must be equipped with features that ensure that the substation can be separated from all energy sources (also power supply).

Emergency

In case of danger or accidents - fire, leaks or other dangerous circumstances - interrupt all energy sources to the station if possible, and seek expert help.
In case of discoloured or bad-smelling domestic hot water, close all shut-off valves on the substation, inform the operating personnel and call for expert help immediately.

Storage

Any storage of the substation which may be necessary prior to installation should be in conditions which are dry and heated.



Authorized personnel only

Assembly, start-up and maintenance work must be performed by qualified and authorized personnel only.



Please observe instructions carefully

To avoid injury to persons and damage to the device, it is absolutely necessary to read and observe these instructions carefully.



Warning of high pressure and temperature

Be aware of the installation's permissible system pressure and temperature.

The maximum temperature of the flow medium in the substation is 120 °C.

The maximum operating pressure of the substation is 10 bar. PN 16 versions are available on enquiry.

The risk of persons being injured and equipment damaged increases considerably if the recommended permissible operating parameters are exceeded.

The substation installation must be equipped with safety valves, however, always in accordance with local regulations.



Warning of hot surface

The substation has got hot surfaces, which can cause skin burns. Please be extremely cautious in close proximity to the substation.

Power failure can result in the motor valves being stuck in open position. The surfaces of the substation can get hot, which can cause skin burns. The ball valves on district heating supply and return should be closed.



Warning of transport damage

Before substation installation, please make sure that the substation has not been damaged during transport.



IMPORTANT - Tightening of connections

Due to vibrations during transport all flange connections, screw joints and electrical clamp and screw connections must be checked and tightened before water is added to the system. After water has been added to the system and the system has been put into operation, re-tighten **ALL** connections.

Operating Guide Termix VMTD MIX-I with complete insulation

4.0 Mounting

4.1 Mounting



Installation must be in compliance with local standards and regulations.

District heating (DH) - In the following sections, DH refers to the heat source which supplies the substations. A variety of energy sources, such as oil, gas or solar power, could be used as the primary supply to Danfoss substations. For the sake of simplicity, DH can be taken to mean the primary supply.

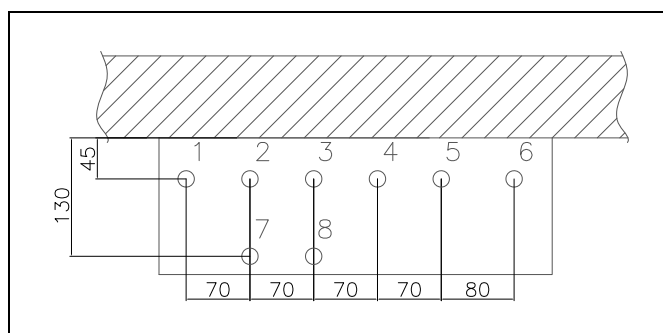


Authorized personnel only

Assembly, start-up and maintenance work must be performed by qualified and authorized personnel only.

Connections:

1. District heating (DH) supply
2. District heating (DH) return
3. Floor heating flow line (FHFL)
4. Floor heating return line (FHRL)
5. Domestic hot water (DHW)
6. Domestic cold water (DCW)
7. Heating (HE) supply
8. Heating (HE) return



The pipe placement can deviate from the shown drawing. Please note the markings on the station.

Connection sizes:

DH + FHFL + FHRL + HE: G ¾" (int. thread)
DCW + DHW: G ¾" (int. thread)

Dimensions (mm):

With insulation: H 610 x W 540 x D 345

Weight (approx.): 25 kg

Operating Guide Termix VMTD MIX-I with complete insulation

4.1.1 Installation

Mounting:

Adequate space

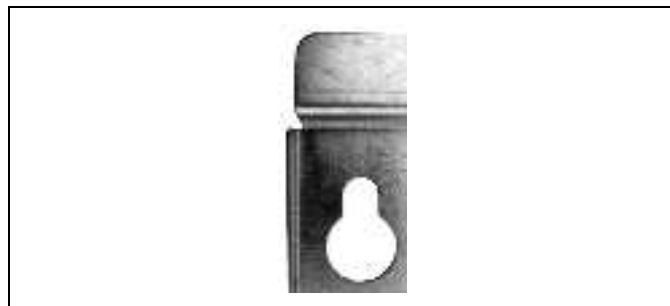
Please allow adequate space around the substation for mounting and maintenance purposes.

Orientation

The station must be mounted so that components, keyholes and labels are placed correctly. If you wish to mount the station differently please contact your supplier.

Drillings

Where substations are to be wall-mounted, drillings are provided in the back mounting plate. Floor mounted units have support.



Keyhole for mounting.

Labelling

Each connection on the substation is labelled.

Before installation:

Clean and rinse

Prior to installation, all substation pipes and connections should be cleaned and rinsed.

Tightening

Due to vibration during transport, all substation connections must be checked and tightened before installation.

Unused connections

Unused connections and shut-off valves must be sealed with a plug. Should the plugs require removal, this must only be done by an authorized service technician.

Installation:

Strainer

If a strainer is supplied with the station it must be fitted according to schematic diagram. Please note that the strainer may be supplied loose.

Connections

Internal installation and district heating pipes connections must be made using threaded, flanged or welded connections.

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4.2 Start-up

Start-up, Heating with mixing loop

Start-up:

1: Pump speed

Set the pump to highest speed before start-up.

2: Start pump

Start the pump and heat through the system.

3: Open shut-off valves

The shut-off valves should then be opened and the unit observed as it enters service. Visual checking should confirm temperatures, pressures, acceptable thermal expansion and absence of leakage. If the system operates in accordance with design, it can be put to regular use.

4: Vent system

Switch off the pump and vent the installation after the radiators have been warmed up.

5: Adjust pump speed

Set the pump to the lowest speed consistent with comfort and electricity consumption. Normally the change-over switch is set in the mid position (default). However for systems with under floor heating or single pipe loop systems, it may be necessary to turn the change-over switch upwards. Higher pump speeds are only used if the heating requirement increases.



Re-tighten connections

After water has been added to the system and the system has been put into operation, re-tighten **ALL** connections.



Pump

The pump must be switched off during system fill.

Under floor heating:

Pump stop function

If the substation is used in connection with under floor heating, the circulation pump must be connected to the pump stop function in the under floor heating controller. The pump must be stopped if all under floor heating circuits are closed.

Warranty

If this is not possible, then flow must be continued through the by-pass. Failing this, the pump will be at risk of seizure and any remaining warranty will be withdrawn.

Summer operation:

Switch off pump

In summer the circulation pump must be switched off and the shut-off valve to HE supply closed.

Running pump bi-weekly

It is recommended to start up the circulation pump (for 2 minutes) once a month during summer; the shut-off valve of the HE supply must be shut.

Electronic controller

Most electronic controllers will start up the pump automatically (please note manufacturer's instructions).

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4.3 Electrical connections

Before making electrical connections, please note the following:

Safety notes

Please read the relevant parts of the safety notes.

230 V

The substation must be connected to 230 V AC and earth.

Potential bonding

Potential bonding should be carried out according to 60364-4-41:2007 and IEC 60364-5-54:2011.

Bonding point on the mounting plate below right corner marked with earth symbol.

Disconnection

The substation must be electrically connected so that it can be disconnected for repairs.

Outdoor temperature sensor

Outdoor sensors should be mounted so as to avoid exposure to direct sunlight. They should not be placed close to doors, windows or ventilation outlets.

The outdoor sensor must be connected to the station on the terminal block under the electronic control.



Authorized electrician

Electrical connections must be made by an authorized electrician only.

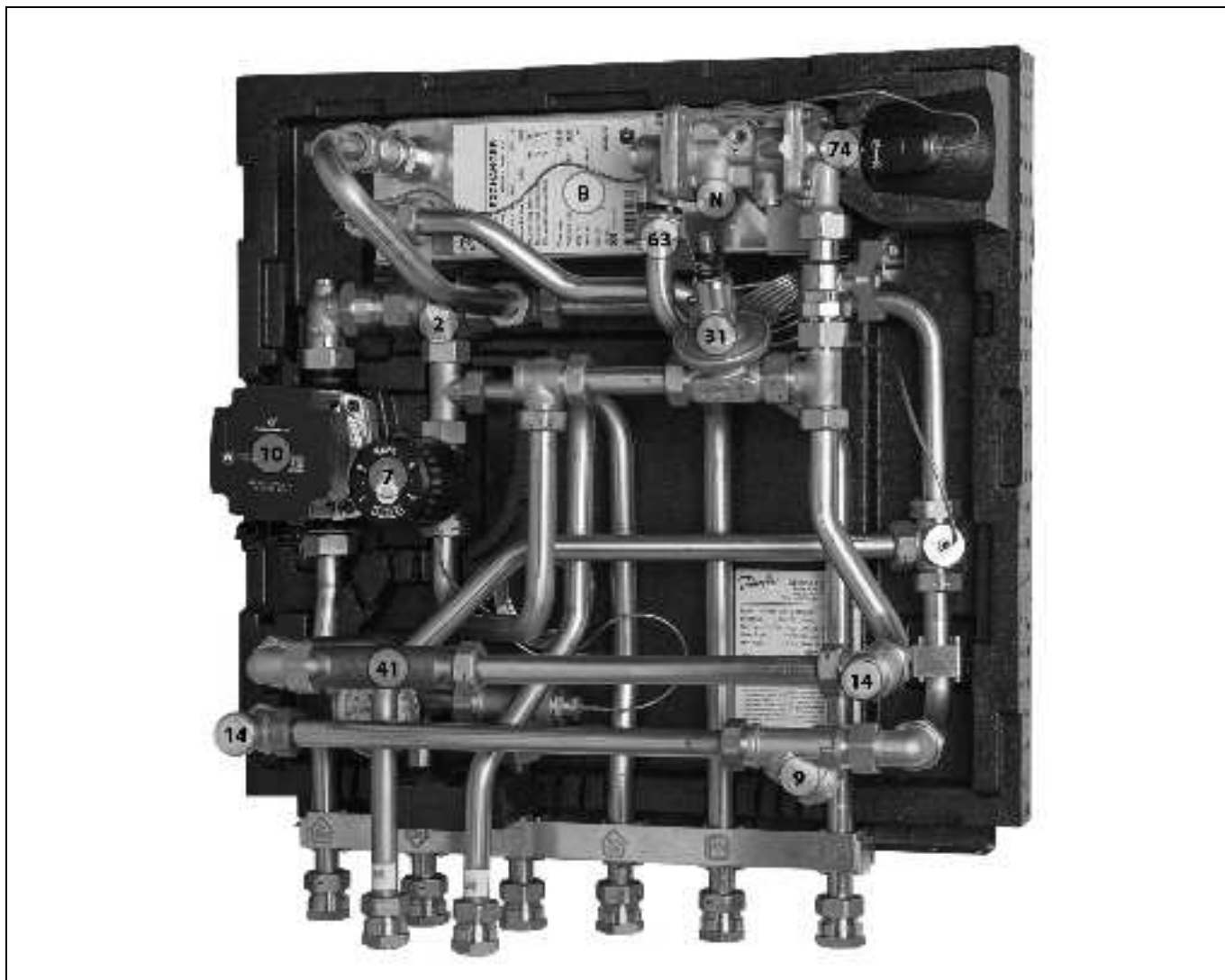
Local standards

Electrical connections must be made in accordance with current regulations and local standards.

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5.0 Design

5.1 Design



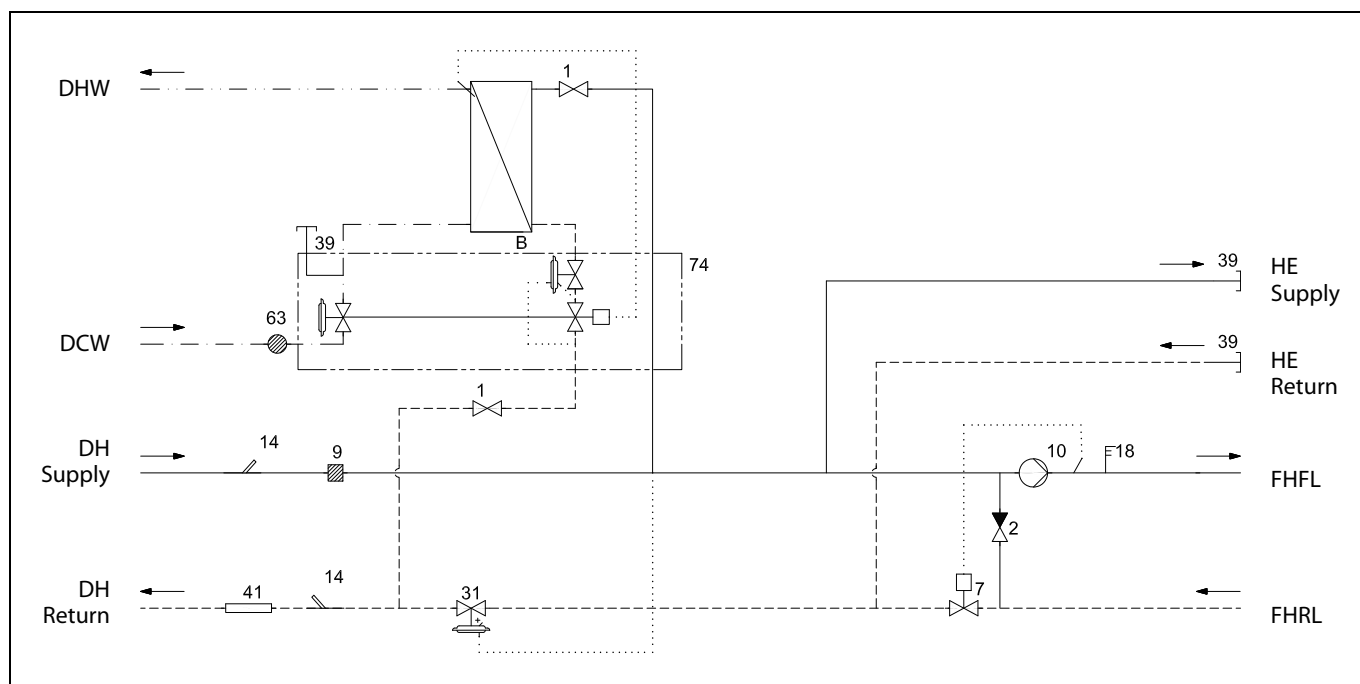
Your substation might look different than the substation shown.

Design description

B	Heat exchanger, DHW	10	Circulator pump, HE
N	Circulation connection	14	Sensor pocket, energy meter
2	Single check valve	31	Differential pressure controller
7	Thermostatic controller, HE	41	Fitting piece, energy meter
9	Strainer	63	Sieve
		74	IHPT controller, DHW

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5.2 Schematic diagram



Your substation might look different than the schematic diagram shown.

Schematic description

B	Heat exchanger, DHW	10	Circulator pump	41	Fitting piece, energy meter
1	Ball valve	14	Sensor pocket, energy meter	63	Sieve
2	Single check valve	18	Thermometer	74	IHPT controller
7	Thermostatic valve	31	Differential pressure controller		
9	Strainer	39	Connection closed		

DHW:	Domestic Hot Water
DCW:	Domestic Cold Water
DH Supply:	District Heating Supply
DH Return:	District Heating Return
HE Supply:	Heating Supply
HE Return:	Heating Return
FHFL:	Floor heating flow line
FHRL:	Floor heating return line

5.2.1 Technical parameters

Technical parameters

Nominal pressure:	PN 10 (PN 16 versions are available on enquiry)
Max. DH supply temperature:	120 °C
Min. DCW static pressure:	1.0 bar
Brazing material (HEX):	Copper
Heat exchangers test pressure:	30 bar
Sound level:	≤ 55 dB

6.0 Controls

6.1 Heating circuit

6.1.1 Differential pressure controller

The differential pressure controller smooths out the fluctuations in pressure arriving from the district heating network. The operating pressure in the substation is thus held steady.



6.1.2 HE temperature control

The HE flow temperature in the heating circuit is controlled by the HE temperature controller.

6.1.3 RAVK controller

RAVK controller (25-65 °C). The temperature setting is as follows:

1 = 25 °C

2 = 35 °C

3 = 45 °C

4 = 55 °C

5 = 65 °C

The values are intended as a guide.

Thermostatic control

The temperature of the HE flow line is adjusted as follows:

To increase temperature, turn the handle on the thermostatic controller to select a higher number.

To decrease temperature, turn the handle on the thermostatic controller to select a lower number.



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6.1.4 Electronic control

Substations with electronic control must be set in accordance with manufacturer's instructions.

Where the room temperature is controlled by radiator thermostats, it is recommended that thermostats be set for minimum temperature in each room.

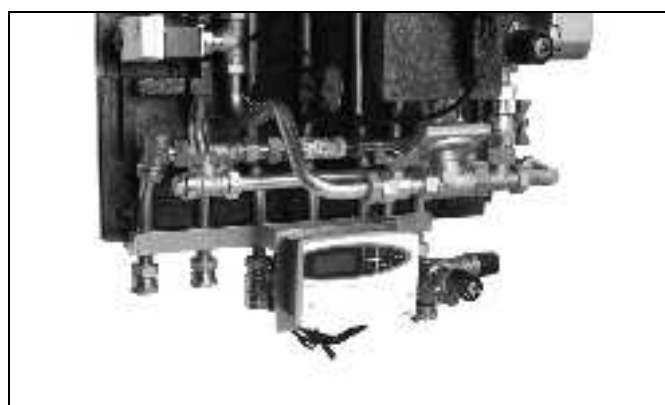


6.1.5 Mounting of electronic controller

The electronic controller must be mounted below the District Heating substation.



The electronic controller must not be situated within the insulation cover due to the ambient temperature.



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6.1.6 Outdoor temperature sensor (ESMT)

Outdoor sensors should be mounted so as to avoid exposure to direct sunlight. They should not be placed close to doors, windows or ventilation outlets.



6.1.7 TP7000

TP7000 electronic 7 day programmable room thermostat. Signals from the room thermostat can be used to control zone valves.



6.1.8 Circulator pump UPM3

UPM3 Pumps can be controlled in constant pressure, proportional pressure or constant speed mode defined by the means of a smart user interface.

The variable speed modulating modes allow the pump to match its performance to the system requirements, helping to reduce noise when thermostatic valves are closing down.

Energy labelling class A



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6.1.9 Grundfos UPM3 AUTO L instructions

Control mode

You can switch from the performance view to the settings view by pressing the push button. The settings view shows which mode controls the circulator. After 2 seconds, the display switches back to performance view.

If you press the button for 2 to 10 seconds, the user interface switches to "setting selection" if the user interface is unlocked. You can change the settings as they appear. The selection of the control mode depends on the system type and the allocation of pressure losses. If you press the key lock for more than 10 seconds, you can toggle between enabling/disabling the key lock function.

Function	Recommended for	Green	Yellow	Yellow	Yellow	Yellow
Proportional pressure 1	1-pipe systems	★	★			
Proportional pressure 2		★	★		★	
Proportional pressure 3	2-pipe systems	★	★		★	★
Constant pressure 1	Under floor heating	★		★		
Constant pressure 2		★		★	★	
Constant pressure 3		★		★	★	★
Constant Curve 1		★	★	★		
Constant Curve 2		★	★	★	★	
Constant Curve 3		★	★	★	★	★
Constant Curve Max.		★	★	★		★

Operation status

Function	Recommended for	Green	Yellow	Yellow	Yellow	Yellow
Standby*	* Only PWM controlled	★				
$0\% \leq P1 \leq 25\%$		★	★			
$25\% \leq P1 \leq 50\%$		★	★	★		
$50\% \leq P1 \leq 75\%$		★	★	★	★	
$75\% \leq P1 \leq 100\%$		★	★	★	★	★

Alarm status

Function	Recommended for	Red	Yellow	Yellow	Yellow	Yellow
Blocked		★				★
Supply voltage low		★			★	
Electrical error		★		★		

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6.2 DHW temperature control

DHW temperature control

There are various types of DHW temperature control used in Danfoss substations.

DHW temperature should be adjusted to 45-50 °C, as this provides optimal utilisation of DH water. At DHW temperatures above 55 °C, the possibility of lime scale deposits increases significantly.

6.2.1 IHPT 90 controller (45–65 °)

IHPT is a self-acting flow-compensated temperature controller with integrated differential pressure controller.

The IHPT operates at its best at DH supply temperatures of up to 100 °C.

By turning the handle for temperature setting in (+) direction the setting is increased, by turning it in (-) direction the setting is decreased.

Turns*	Scale	DHW Temperature Setting [°C]
0	7	64
1	6	61
2	5	58
3	4	55
4	3	52
5	2	48
6	1	44
7	0	43

*Start position: Handle turned fully in (+) direction.
The values are intended as a guide.



6.3 Other

6.3.1 Safety valve

The purpose of the safety valve is to protect the substation from excessive pressure.

The blow-off pipe from the safety valve must not be closed. The blow-off pipe outlet should be placed so that it discharges freely and it is possible to observe any dripping from the safety valve. It is recommended to check the operation of safety valves at intervals of 6 months. This is done by turning the valve head in direction indicated.



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6.3.2 Strainer

Strainers should be cleaned regularly by authorized personnel. The frequency of cleaning would depend on operating conditions and the manufacturer's instructions.



6.3.3 GTU Pressure Equalizer

The GTU Pressure Equalizer absorbs the expansion on the secondary side of the Termix water heaters and can be used as a substitute to the safety valve. Furthermore the pressure equalizer absorbs a possible increase in pressure, so a discharge outlet is omitted. The GTU Pressure Equalizer may not be applied in systems with hot water circulation.



6.3.4 Fitting piece

The substation is equipped with a fitting piece for energy meter.

Assembly of energy meters:

1: Close ball valves

Close the ball valves on DH Supply and DH Return, if there is water on the system.

2: Loosen nuts

Loosen the nuts on the fitting piece.

3: Remove fitting piece

Remove the fitting piece and replace it with the energy meter. Do not forget the gaskets.

4: Tighten connections

After mounting of the energy meter remember to check and tighten all threaded connections.



Sensor pocket, energy meter

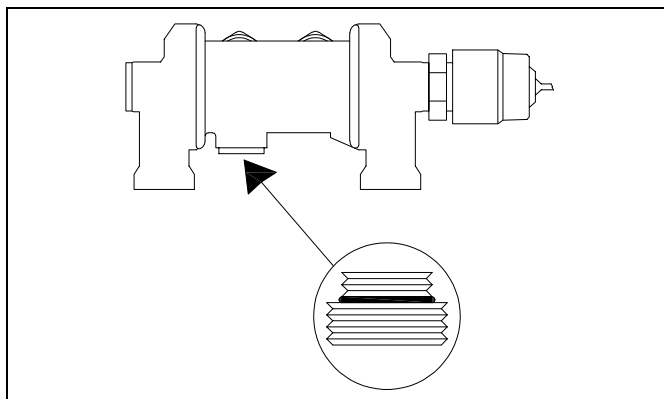
The sensors of the energy meter is mounted in the sensor pockets.



6.4 Extras

6.4.1 Circulation pipe

The circulation pipe set is mounted directly on the controller. The set includes circulation pipe, single check valve and fitting. When mounting the hot water circulation directly on the controller the hot water circulation temperature will be equal to the idle temperature. The idle temperature is a few degrees lower than the set domestic hot water temperature.



6.5 Mounting plate for energy meter display

Bracket for the display of the energy meter delivered loose with the District Heating substation.



Mount the wall clip for the display onto the bracket.



Fix the bracket onto the pipe clips using a pair of pliers.



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Slide the display of the energy meter on the clip.



The display is now neatly positioned below the District Heating substation.



6.6 Maintenance

The substation requires little monitoring, apart from routine checks. It is recommended to read the energy meter at regular intervals, and to write down the meter readings.

Regular inspections of the substation according to this Instruction are recommended, which should include:

Strainers

Cleaning of strainers.

Meters

Checking of all operating parameters such as meter readings.

Temperatures

Checking of all temperatures, such as DH supply temperature and DHW temperature.

Connections

Checking all connections for leakages.

Safety valves

The operation of the safety valves should be checked by turning the valve head in the indicated direction.

Venting

Checking that the system is thoroughly vented.

Inspections should be carried out minimum every two years.

Spare parts can be ordered from Danfoss. Please ensure that any enquiry includes the substation serial number.



Authorized personnel only

Assembly, start-up and maintenance work must be performed by qualified and authorized personnel only.

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7.0 Troubleshooting

7.1 Troubleshooting in general

In the event of operating disturbances, the following basic features should be checked before carrying out actual troubleshooting:

- the substation is connected to electricity,
- the strainer on the DH supply pipe is clean,
- the supply temperature of the DH is at the normal level (summer, at least 60 °C - winter, at least 70 °C),
- the differential pressure is equal to or higher than the normal (local) differential pressure in the DH network – if in doubt, ask the DH plant supervisor,
- pressure on the system - check the HE pressure gauge.



Authorized personnel only

Assembly, start-up and maintenance work must be performed by qualified and authorized personnel only.

7.2 Troubleshooting DHW



Problem	Possible cause	Solution
Too little or no DHW.	Strainer in supply or return line clogged.	Clean strainer(s).
	DHW circulation pump out of order or with too low setting.	Check circulation pump.
	Defective or clogged non-return valve.	Replace – clean.
	No electricity.	Check.
	Wrong setting of automatic controls, if any.	To adjust an electronic controller for DHW, pls. note enclosed instructions for electronic controller.
	Scaling of the plate heat exchanger.	Replace – rinse out.
	Defective motorized valve.	Check (use manual function) – replace.
	Defective temperature sensors.	Check – replace.
	Defective controller.	Check – replace.
Hot water in some taps but not in all.	DCW is being mixed with the DHW, e.g. in a defective thermostatic mixing valve.	Check – replace.
	Defective or clogged non-return valve on circulation valve.	Replace – clean.
Tap temperature too high; DHW tap load too high.	Thermostatic valve adjusted to a too high level.	Check – set.
Temperature drop during tapping.	Scaling of the plate heat exchanger.	Replace – rinse out.
	Larger DHW flow than the substation has been designed for.	Reduce DHW flow.
Thermostatic control valve does not close	Temperature difference between DH supply and DHW set point too low.	Lower the set point temperature or increase the DH supply temperature.
Idle temperature too low (for stations equipped with IHPT).	Set point too low.	Turn thermostat in (+) direction.

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7.3 Troubleshooting HE



Problem	Possible cause	Solution
Too little or no heat.	Strainer clogged in DH or HE circuit (radiator circuit).	Clean gate/strainer(s).
	The filter in the energy meter on DH circuit clogged.	Clean the filter (after consulting the DH plant operator).
	Defective or wrongly adjusted differential pressure controller.	Check the operation of the differential pressure controller – clean the valve seat if required.
	Sensor defective – or possibly dirt in the valve housing.	Check the operation of the thermostat – clean the valve seat if required.
	Automatic controls, if any, wrongly set or defective - possibly power failure.	Check if the setting of the controller is correct – see separate instructions. Check the power supply. Temporary setting of motor to “manual” control – see instructions on automatic controls.
	Pump out of operation.	Check if the pump is receiving power and that it turns. Check if there is air trapped in the pump housing – see pump manual.
	The pump is set at too low speed of rotation.	Set the pump at higher speed of rotation.
	Pressure drop – the pressure drop on the radiator circuit shows lower than recommended operating pressure.	Fill water on the system and check the functioning of the pressure expansion vessel if required.
	Air pockets in the system.	Vent the installation thoroughly.
	Limiting of the return temperature adjusted too low.	Adjust according to instructions.
	Defective radiator valves.	Check – replace.
	Uneven heat distribution in building because of incorrectly set balancing valves, or because there are no balancing valves.	Adjust/install balancing valves.
	Diameter of pipe to substation too small or branch pipe too long.	Check pipe dimensions.
Uneven heat distribution.	Air pockets in the system.	Vent the installation thoroughly.
DH supply temperature too high.	Wrong setting of thermostat or of automatic controls, if any.	Adjust automatic controls, – see instructions for automatic controls.
	Defective controller. The controller does not react as it should according to the instructions.	Call automatic controls manufacturer or replace the regulator.
	Defective sensor on self-acting thermostat.	Replace thermostat – or sensor only.
DH supply temperature too low.	Wrong setting of automatic controls, if any.	Adjust automatic controls – see instructions for automatic controls.
	Defective controller. The controller does not react as it should according to the instructions.	Call in automatic controls manufacturer or replace controller.
	Defective sensor on self-acting thermostat.	Replace thermostat – or sensor only.
	Wrong placement/fitting of outdoor temperature sensor.	Adjust location of outdoor temperature sensor.
	Strainer clogged.	Clean gate/strainer.

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Too high DH return temperature.	Too small heating surface/too small radiators compared to the total heating requirement of the building.	Increase total heating surface.
	Poor utilization of existing heating surface. Defective sensor on self-acting thermostat.	Make sure the heat is distributed evenly across the full heating surface – open all radiators and keep the radiators in the system from heating up at the bottom. It is extremely important to keep the supply temperature to the radiators as low as possible, while maintaining a reasonable level of comfort.
	The system is single pipe loop.	The system should feature electronic controls as well as return sensors.
	Pump pressure too high.	Adjust pump to a lower level.
	Air in system.	Vent the system.
	Defective or incorrectly set radiator valve(s). Single pipe loop systems require special one-pipe radiator valves.	Check – set/replace.
	Dirt in the motorized valve or in the differential pressure controller.	Check – clean out.
	Defective motorized valve, sensor or automatic controller.	Check – replace.
	Electronic controller not adjusted correctly.	Adjust according to instructions.
Noise in system.	Pump pressure too high.	Adjust pump to a lower level.
Heat load too high.	Defective motorized valve, sensor or electronic controller.	Check – replace.

7.4 Disposal

	Disposal This product should be dismantled and its components sorted, if possible, in various groups before recycling or disposal. Always follow the local disposal regulations.
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Operating Guide Termix VMTD MIX-I with complete insulation

8.0 Declaration

8.1 Declaration of conformity

Catégorie 0 avec équipement électrique



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EU-DECLARATION OF CONFORMITY

Danfoss A/S
Danfoss District Energy Division

declares under our sole responsibility that the product(s)

Small substations - type:

Termix One Solar, Termix Solar A+, Termix Solar B+, Termix FLS, KST1, Termix BV, Termix BL, Termix VMTD MIX-IE, Termix VMTD MIX-B, Termix VMTD MIX-I, Termix VMTD-F-MIX-B, Termix VMTD-F-MIX-I, Termix VX, Termix VX-W, Termix VXM-W, Termix VX-WP, Termix VVX, Termix VVX-B, Termix VVX-L, Termix BTM MIX, Termix BVX, Termix VMTD Compact 28, Termix VMTD Compact 32, Termix VX Compact 28, Termix VX Compact 32, Termix VVX Compact 28, Termix VVX Compact 32.

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

Machinery Directive 2006/42/EC

DS/EN 60204-1/A1:2009, Safety of machinery - Part 1 - General Requirements.
DS/EN 12100:2011, Safety of machinery - Risk assessment.

Low Voltage Directive (LVD) - 2014/35/EU

DS/EN 60204-1/A1:2009, Safety of machinery - Part 1 - General Requirements

EMC - Directive - 2014/53/EU

DS/EN 61000-6-1:2007
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DS/EN 61000-6-2:2005.
Electromagnetic compatibility - Generic standard. Immunity industry.

DS/EN 61000-6-3:2007, Electromagnetic compatibility - Generic standard. Emission for residential, commercial & light industry.

Date 12-1-2017	Issued by <i>Clas G. Mortensen</i> Clas G. Mortensen	Date 12/17	Approved by <i>[Signature]</i> Clas G. Mortensen
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