### **IMPORTANT!**

DO NOT CROSS OR CUT THE HEATING CABLE.
REMEMBER TO MEASURE, VERIFY AND
RECORD THE RESISTANCE. USE A MEGGER TO
TEST THE RESISTANCE TO GROUND.





# **Installation Manual**

Danfoss TX-SH Storage Heating Cables and Mats







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### **Danfoss TX Thermal Storage Heating System**



#### **Danfoss TX Thermal Storage Heating System**

The TX Thermal Storage Heating System consists of heating cables installed in the foundation of a building either in the concrete slab, or in the sand bed below the concrete slab. Control of the heating cables is achieved via the LX thermostat with an air temperature sensor and floor temperature limiter. The LX thermostat has a built in Ground Fault Current Interrupt (GFCI). A separate magnetic contactor and GFCI are required for current loads above 16A.

The principle of thermal storage heating consists of heating a concrete slab. One of the economic benefits of Danfoss TX is that it can make effective use of off-peak electricity pricing. The slab is thus charged with heat which then gently radiates to the building above throughout the day, providing a comfortable, efficient and reliable heat source.

Benefits of the TX thermal storage are numerous over other heating methods, and include:

- Lower capital and operating costs
- Easy and flexible installation combined with a single point connection.
- Reclaimed interior floor space (no furnace/boiler required)
- Decorating freedom (no heating registers to keep clear)
- Silent, safe, and efficient operation
- No cold spots
- Energy efficiency
- Reduced dust and allergens
- •Higher degree of comfort.

Versatile and easy to install the Danfoss TX thermal storage system is the optimal way to heat your residential, commercial or industrial building.

#### **CAUTION!**

Danfoss TX is a heating system usually intended to be the sole source of heat in the building. Danfoss Strongly recommends consulting with a building engineer, architect or qualified professional to ensure that the Danfoss TX thermal storage system selected will be suitable for your intended application.



### **Specifications:**



Note: TX cables operated on a 208V power supply will experience a 25% power reduction.

40°F (5°C)

#### Connection (all voltages)

Min. Installation Temp.:

Phase - Black Phase - White Ground - Green

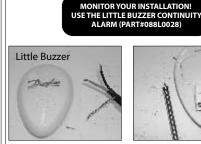
### Measuring the resistance

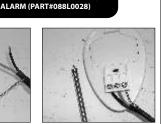
### **WARNING:** Remember to measure resistance.











Using a digital Ohmmeter, the resistance should be measured between the black and white conductors. Compare the measured resistance to the resistance listed on the product label (on the power lead).

Also, measure the resistance between the black and green (ground) wires, and between the white and green (ground) wires to test the insulation resistance. Both should should have infinite resistance. If available, Danfoss recommends using a megger for this test with a voltage setting of up to 2500V.

Record the resistance on your warranty card. Documenting the resistance at each stage of the installation is required for warranty purposes. If the resistances do not match the expected values, the cable may need to be damaged and need repair. Contact your Danfoss representative for a repair kit (part # 088L0010)

While not required, you may also want to measure the resistance of the floor sensor. It should be approximately  $12k\Omega$  at room temperature.



#### **GENERAL NOTES**

### **Read before beginning foundation!**



- The installation shall be in accordance with the manufacturer's instructions and national and local electrical codes. The installation shall be in accordance with Part 426, American National Standard Institute / National Fire Protection Association (ANSI/NFPA70), National Electrical Code (NEC) and Canadian Electrical Code (CEC), Part 1. You must use a ground fault protection device (GFCI) or a Residual Current Device (RCD).
- All local codes concerning buildings, electrical installations etc. must be adhered
  to regardless of instructions provided in this manual. If these regulations are in
  direct conflict with instructions stated herein, please contact the Danfoss
  Electrical Heating Division.
- It is important that this equipment is only installed by qualified electricians who
  are familiar with the proper sizing, installation, construction and operation of
  electric heating cable systems and the hazards involved. The TX system is only
  designed for installation in concrete or sand applications.
- Metal structures or materials used for the support of or on which the Danfoss TX is installed must be grounded in accordance with CSA Standard C22.1, Section 10 and the NEC.
- It is recommended to install the Danfoss TX heating cables/mat with a controller that contains an integrated temperature limiter;
- Remember to check that the supply voltage matches the voltage required for your particular Danfoss TX product;
- Extreme care must be used to ensure the TX cables are not damaged when using sharp tools, wheelbarrows, heavy machinery, shovels, rakes, or other implements. Avoid walking on the cables or mats during installation;



### **GENERAL NOTES (continued)**

### **Read before beginning foundation!**



READ THESE INSTRUCTIONS BEFORE BEGINNING THE CONSTRUCTION OF THE FOUNDATION

- · Never cut the heating cable;
- Do not install the Danfoss TX cables in such a manner that two heating cables touch, cross or overlap;
- Measure, verify and record the actual resistance throughout the installation process:
  - 1. Out of the box
  - 2. After installation
  - 3. After laying the sand bed (for sand bed installation)
  - 4. After the concrete slab is poured (but not set)
  - 5. After connecting thermostat and/or contactors

Record these values in the warranty card. Failure to do so will void the warranty;

- The Danfoss TX thermal storage heating system is most effective in single story buildings, with tiled or stone or concrete floors. If carpet, wood or other flooring materials are to be used, please consult with Danfoss Electrical Heating Division.
- The TX mat or TX cable must be embedded in mortar or mortar mixture, concrete, sand or similar material. Ensure no air pockets exist in the concrete or sand. This can damage to the cable.
- The perimeter of the heated area should be insulated to 4ft below grade with a
  minimum of 2in of rigid, closed cell foam insulation (styrofoam) or equivalent suitable
  for in-ground installation. Foamed urethane or polystyrene are not acceptable
  moisture reduced its insulation properties.
- Ensure that all sharp stones and debris are removed from the area where the heating cables are going to be installed.
- Make sure the cable is not subjected to excessive tension or strain, especially at the heating cable to power lead slice. It should not cross an expansion joint when installed in concrete. For two or more slabs, use of separate cables in each slab is recommended.
- At low temperatures, the heating cable stiffens and may be difficult to work with. To overcome this, connect the cable to the mains for a brief period of time. Ensure the cable is fully rolled out when this is done.
- A minimum of 12in (30 cm) should exist between the cables and the perimeter of the foundation, and obstructions such as drains, conduits, and structural members.
- There should be a minimum of 2in (5 cm) of concrete or sand above and below the heating cables.
- Allow the concrete to set for at least 30 days before the heating cables are turned on.
- There should not be any <u>moving</u> groundwater in the building area. Natural moisture in the soil is acceptable. If in doubt, contact Danfoss Electric Heating Division.
- Please consult the Danfoss Electrical Heating Division for any other questions, concerns or advice.

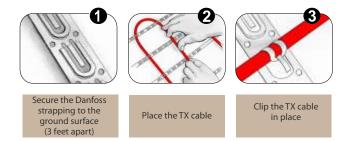


#### **General TX Cable Installation Guidelines**



#### Free Cable and Cable Strapping

Should the Danfoss cable strapping be used for the TX cable, follow the instructions below for ease of installation.



### Installing the heating cable



The TX cable must be laid out with even spacing over the entire area to be heated. To ensure an accurate and easy method of installing the TX cable it is recommended to use Danfoss cable strapping. The strapping should be laid perpendicular to the direction the cable will be unrolled. Space the strapping 3ft (90cm) apart. Secure the heating cable to the cable strapping at the correct center-to-center distance. Do not secure the cable too tightly as this may damage the cable.

If rebar or wire mesh is available, the cable strapping is not required. The heating cable can be attached directly to the rebar or wire mesh using tie wraps.

### Center-to-center (C-C) distance



To determine the approximate c-c distance with TX cables, the following formula below can be used, or consult with the engineer responsible for the building construction. To determine the

Cable Length 
$$(ft) = \frac{Power(W)}{9}$$

Since the length will not exactly match a Danfoss TX cable, select an appropriate combination of cables. Then proceed to calculate the c-c distance:

$$c - c (in) = \frac{Area(ft^2) \times 12}{Cable Length (ft)}$$

#### **EXAMPLE:**

A 683 sq.ft. area requires a heating cable set with a power of 9200W. The nearest combination is a 545 ft cable and a 475 ft cable for a total length of 1020 ft. With this cable length, the appropriate spacing is approx. 8in.

Cable Length (ft) = 
$$\frac{9200}{9}$$
 = 1022 ft  $c-c = \frac{683 \times 12}{1020}$  = 8.03"

TIP: If using Danfoss strapping to secure the cable, remember that the tabs are 1 in increments. You may want to vary the alternate spacing to achieve the required average c-c distance. Example: if you need 8.5in, alternate spacing at 8in and 9in.



### **General TX Mat Installation Guidelines**

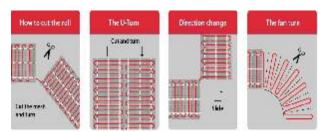


#### **Planning**

It is recommended to sketch a plan of the layout for the heating system installation. Mat location, sensor placement, junction boxes, conduits and the location of drains and other obstructions should be noted.

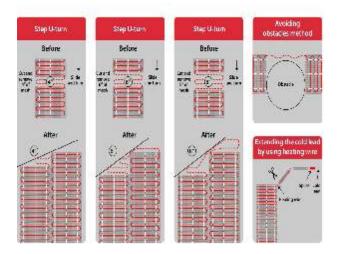
#### **Mat Alterations**

The TX heating mats can be altered to accommodate drains, obstructions or bends in the layout. By carefully cutting the mat tape, many patterns and designs can be created. The figure below illustrates this.



#### **WARNING!**

# DO NOT CUT THE HEATING CABLE



### Installing the heating mat



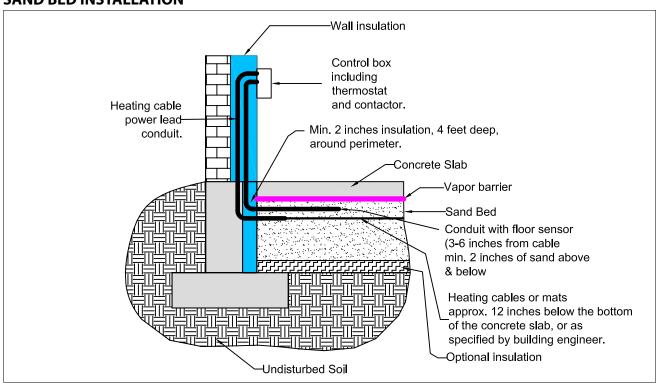
Begin by fastening the heating mat to the mesh reinforcement using tie-wraps or cable strapping. Do not fix the heating cable of the mat in such a way that it is compressed or strained - it must be able to move. Unroll the mat up to the point at which it is to be flipped and turned. Use the figure above for suggestions on how to alter the mat.

Cut the tape using scissors and rotate the mat so that it can be unrolled to cover the area next to the already unrolled mat. **Do not cut the cable!** The cable can be carefully detached from the tape and then placed as free cable. This feature can be very useful for curves and around drains or other obstructions.

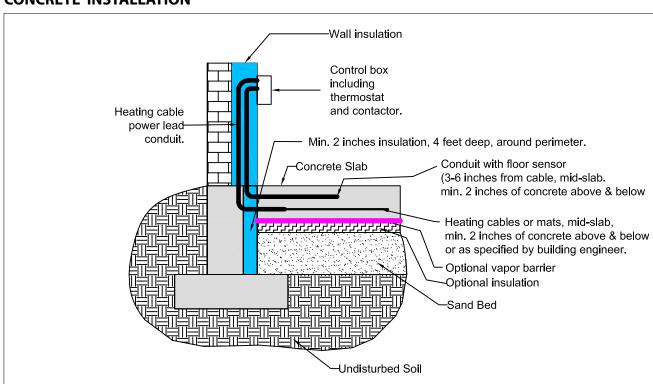


### **Danfoss TX Typical Installation Diagram**

#### SAND BED INSTALLATION



#### **CONCRETE INSTALLATION**





### **Danfoss TX Installation in Concrete Slab - Step by Step**

#### **STEP 1: PLAN YOUR LAYOUT**

Make a sketch of the area to be covered with heating TX cables/mats. Determine the location of fixtures such as drains, pipes, electrical conduits, structural members. Remember to keep a distance of 12in (30cm) around such obstacles. All obstacles that shall be in the concrete slab should be installed prior to Danfoss TX installation to avoid damaging the cable.

You should also plan the location of the thermostats, floor sensors locations and their conduit's location. The start of cables/mats should be as close as possible to the thermostat's final placement. For quidelines on cable or mat installation, see page 6 or 7 of this manual.

#### STEP 2: INSTALLING THE FLOOR SENSOR AND CONDUIT

A floor sensor for high temperature protection must be installed in a rigid conduit. The conduit protects sensor and facilitates its replacement in the unlikely event of failure.

The sensor and the conduit may be installed in connection with the actual construction work and connected at a later date. Please observe the following:

- 1. Ensure that the conduit is sealed before the concrete is poured.
- 2. The conduit must be positioned between the heating cables. This is usually at approximately the mid-point of the concrete slab.
- 3. Danfoss recommends to keep the conduit as short as possible and to minimize the number of bends in the conduit. This will ease the installation of the sensor.
- 4. Place the sensor inside the tube until it reaches the end of the conduit.
- 5. The sensor and conduit should be placed within 3in to 6in of the heating cables and with at least 2in of concrete or sand above and below.
- 6. The floor sensor should be installed at least 3ft (1m) into the heated area.
- 7. The floor sensor has a standard 10ft (3m) lead that may be extended with 20 AWG wire.

#### STEP 3: MEASURE THE RESISTANCE OF THE HEATING CABLE

Using a digital ohm-meter, measure the resistance of the TX cable. Compare the measured value with the resistance listed on the label of the power lead. See page 3 for details.

Remember to record the measured resistances on the warranty card. Documenting the resistance at each stage of the installation is required for warranty purposes.

#### STEP 4: INSTALLING THE TX CABLE/MAT

Install the cable/mat. The cable and mat is usually installed attached to the rebar or wire mesh of the foundation. For details on this, see page 6 and 7 of this manual. For cable installation, you may need to install the cable strapping before installing the TX cable. The cables should be approximately at the midpoint of the slab, but in all cases, it is recommended to have at least 2" of concrete above and below the cables.

The power lead to heating junction and at least 12in (30 cm) of the power lead must be embedded in the mass material. The remainder of the power lead should be in a conduit that extends to the thermostat or contactor. The power lead may be extended if required.

Measure the resistance once again as outlined in step 3, and record the information on the warranty card.

TIP: Danfoss recommends taking a picture of the cable/mat layout and conduit placement during installation. This can help in the unlikely case that the cables/mats need repairs and for warranty claims.



### **Danfoss TX Installation in Concrete Slab - Step by Step (Continued)**

#### STEP 5: POUR THE CONCRETE SLAB

Pour the concrete slab. Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc. Once the slab is poured but concrete is still wet, measure the resistance once again as outlined in step 3, and record the information on the warranty card.

It is not recommended to power the cables/mats for until the concrete has cured (approximately 30 days). Check with the concrete manufacturer for exact curing times. Doing so can affect both the integrity of the slab, and the subsequent proper operation of the TX cables/mats.

#### **STEP 6: CONNECT POWER SUPPLY AND THERMOSTAT**

The connection of the LX thermostat must be done by a qualified electrician familiar with heating cables and in accordance with the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). Remember to properly ground the heating cable braid.

If this is not already done, the sensor should be installed in the conduit. Remember that the sensor should reach the sealed end of the conduit. Connect the thermostat and sensor according to the wiring diagram in appendix A.

A final resistance reading of the cables should be carried out as discussed in step 3 and the measured values recorded on the warranty card.

#### STEP 7: RECORD INFORMATION AND AFFIX LABELS

- Ensure that all resistances measured in steps 3 to 6 are recorded on the warranty card.
- The eight digit product code found on the TX cable/mat power lead must be recorded on the warranty certificate.
- Install the electrical panel label at the electrical panel, indicating the location of the cable.
- Install the Warning label in a visible area of the floor, for the duration of the construction. It is also recommended that the label be kept in a suitable location on a permanent basis.

#### **STEP 8: ENJOY THE COMFORT OF DANFOSS TX**

The TX thermal storage heating system is now ready to use. Increase the temperature gradually and adjust it until it reaches a level that suits your personal preferences.

Note that it may take several hours for the thermal mass to heat up the first time the system is powered, or after extended periods of inactivity.



### **Danfoss TX Installation in Sand Bed - Step by Step**



#### **STEP 1: PLAN YOUR LAYOUT**

Make a sketch of the area to be covered with heating TX cables/mats. Determine the location of fixtures such as drains, pipes, electrical conduits, structural members. Remember to keep a distance of 12in (30cm) around such obstacles. All obstacles that shall be in the concrete slab and sand bed should be installed prior to Danfoss TX installation to avoid damaging the cable.

You should also plan the location of the thermostats, floor sensors locations and their conduit's location. The start of cables/mats should be as close as possible to the thermostat's final placement.

For guidelines on cable or mat installation, see page 6 or 7 of this manual.

#### **STEP 2: STARTING THE SAND BED**

Ensure that the ground below the sand bed is well compacted, free of organic materials, and generally suitable for a stable for laying a suitable foundation. Proceed to fill the area with washed masonry sand. The sand should be free of organic material, stones, debris or any other object that could damage the cable. Moisten, and compact the sand. Raise the sand to a level of 12in below the bottom of the concrete slab, or as specified by the engineer. The layer of sand should be at least 2in thick.

#### STEP 3: INSTALLING THE FLOOR SENSOR AND CONDUIT

A floor sensor for high temperature protection must be installed in a rigid conduit. The conduit protects sensor and facilitates its replacement in the unlikely event of failure.

The sensor and the conduit may be installed in connection with the actual construction work and connected at a later date. Please observe the following:

- 1. Ensure that the conduit is sealed before the sand is laid.
- 2. The conduit must be positioned between the heating cables. This is usually a 12in below the bottom of the concrete slab.
- 3. Danfoss recommends to keep the conduit as short as possible and to minimize the number of bends in the conduit. This will ease the installation of the sensor.
- 4. Place the sensor inside the tube until it reaches the end of the conduit.
- 5. The sensor and conduit should be placed within 3in to 6in of the heating cables and with at least 2in of concrete or sand above and below.
- 6. The floor sensor should be installed at least 3ft (1m) into the heated area.
- 7. The floor sensor has a standard 10ft (3m) lead that may be extended with 20 AWG wire.

#### STEP 4: MEASURE THE RESISTANCE OF THE HEATING CABLE

Using a digital ohm-meter, measure the resistance of the TX cable. Compare the measured value with the resistance listed on the label of the power lead. See page 3 for details on measuring the resistance.

Remember to record the measured resistances on the warranty card. Documenting the resistance at each stage of the installation is required for warranty purposes.



### **Danfoss TX Installation in Sand Bed - Step by Step (Continued)**

#### STEP 5: INSTALLING THE TX CABLE/MAT

Install the TX cable/mat according to the sketch made in step 1. The cable/mat should be secured to prevent movement in subsequent steps. For details, see page 6 and 7 of this manual. For cable installation, you may need to install the cable strapping before installing the TX cable.

The power lead to heating junction and at least 12in (30 cm) of the power lead must be embedded in the mass material. The remainder of the power lead should be in a conduit that extends to the thermostat or contactor. The power lead may be extended if required.

Measure the resistance once again as outlined in step 4, and record the information on the warranty card.

TIP: Danfoss recommends taking a picture of the cable/mat layout and conduit placement during installation. This can help in the unlikely case that the cables/mats need repairs and for warranty claims.

#### **STEP 6: FINISHING THE SAND BED**

Continue raising the sand bed with washed masonry sand, to approximately 1in below the base of the future concrete slab. Once again sand should be free of organic material, stones, debris or any other object that could damage the TX cables. Gently wet the compacted sand until completely saturated with water.

Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc.

Install a vapor barrier over the sand bed with 6"in of overlap for adjacent sheets. Finish the sand bed with an additional 1in of compacted sand. This will help to prevent movement of the vapor barrier when during subsequent steps.

Measure the resistance once again as outlined in step 4, and record the information on the warranty card.

It is not recommended to power the cable at this time.

#### STEP 7: POUR THE CONCRETE SLAB

Pour the concrete slab. Ensure that the contractors are careful not to damage the cable with tools, heavy machinery, etc. Once the slab is poured but concrete is still wet, measure the resistance once again as outlined in step 4, and record the information on the warranty card.

It is not recommended to power the cables/mats for until the concrete has cured (approximately 30 days). Check with the concrete manufacturer for exact curing times. Doing so can affect both the integrity of the slab, and the subsequent proper operation of the TX cables/mats.



### **Danfoss TX Installation in Sand Bed - Step by Step (Continued)**

#### STEP 8: CONNECT POWER SUPPLY AND THERMOSTAT

The connection of the LX thermostat must be done by a qualified electrician familiar with heating cables and in accordance with the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). Remember to properly ground the heating cable braid.

If this is not already done, the sensor should be installed in the conduit. Remember that the sensor should reach the sealed end of the conduit. Connect the thermostat and sensor according to the wiring diagram in appendix A.

A final resistance reading of the cables should be carried out as discussed in step 4 and the measured values recorded on the warranty card.

#### STEP 9: RECORD INFORMATION AND AFFIX LABELS

- •Ensure that all resistances measured in steps 4 to 8 are recorded on the warranty card.
- The eight digit product code found on the TX cable/mat power lead must be recorded on the warranty certificate.
- Install the electrical panel label at the electrical panel, indicating the location of the cable.
- Install the warning label in a visible area of the floor, for the duration of the construction. It is also recommended that the label be kept in a suitable location on a permanent basis.

#### STEP 10: ENJOY THE COMFORT OF THE DANFOSS TX

The TX thermal storage heating system is now ready to use. Increase the temperature gradually and adjust it until it reaches a level that suits your personal preferences.

Note that it may take several hours for the thermal mass to heat up the first time the system is powered, or after extended periods of inactivity.



# **EXTENDED WARRANTY**

For a period of ten (10) years from the date of purchase Danfoss warrants that the Danfoss TX cable is free from defects in material, design and workmanship. The extended warranty is only valid if the warranty certificate has been properly completed and mailed, and the installation is in accordance with the installation instructions.

The defective Danfoss TX cable has to be inspected by or submitted to Danfoss or an authorized Danfoss TX dealer. Failure to comply with all of the foregoing will void this extended warranty. Danfoss will, when the customer has documented that a defect in the Danfoss TX cable was present at the date of delivery, repair or supply a new Danfoss TX cable at Danfoss' option. All claims shall be made within the extended warranty period. Danfoss shall not be liable for any claims made later than ten years from date of purchase.

Danfoss shall not be liable for any consequential and secondary costs or damages linked to the defect or replacement of the Danfoss TX cable. Danfoss will be liable for any costs related to the dismantling of defective product and the installation of a new product; however such liability is limited to the amount of five (5) times the initial product costs for each damage/case.

THE FOREGOING WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ON THE PART OF DANFOSS. DANFOSS DISCLAIMS ANY WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DANFOSS NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON, FIRM OR CORPORATION TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH SALE OR PRODUCT. DANFOSS SHALL NOT BE HELD RESPONSIBLE FOR DAMAGE TO PERSON OR PROPERTY, CONSEQUENTIAL LOSS, LOSS OF PROFIT, LOSSES ON GOODS IN STORE, OR THE LIKE WHICH MIGHT ARISE OUT OF THE FAILURE OF THE EQUIPMENT DELIVERED, IRRESPECTIVE OF THE CAUSE (INCLUDING FAULTY MANUFACTURE).

### How to claim this warranty

Contact the company's Customer Service department and provide the following information:

- 1) Nature of the manufacturing defect
- 2) Date of purchase and, if already installed, date of installation
- 3) If installed, name of electrician and foundation installer
- 4) Resistance readings taken by installer
- 5) Proof of purchase and serial number from product label

Our Customer Service department will provide you with an authorization number and advise you on the next steps to complete your warranty claim.

#### **Disclaimer:**

This warranty gives you specific legal rights and you may also have some legal rights which may vary from state to state or province to province. Danfoss hereby disclaims, and it is as a condition of the sale, that there are no implied warranties. Some states and provinces do not allow limitations on an implied warranty so the above limitation may not apply to you.

#### **Manufacturer:**

Mail: Danfoss Inc.

6711 Mississauga Rd.,

Suite 410 Toronto, ON L5N 2W3

Phone: 905-285-2050

1-866-676-8062

Fax: 905-285-2055



### **APPENDIX A: TYPICAL DANFOSS TX WIRING DIAGRAM**

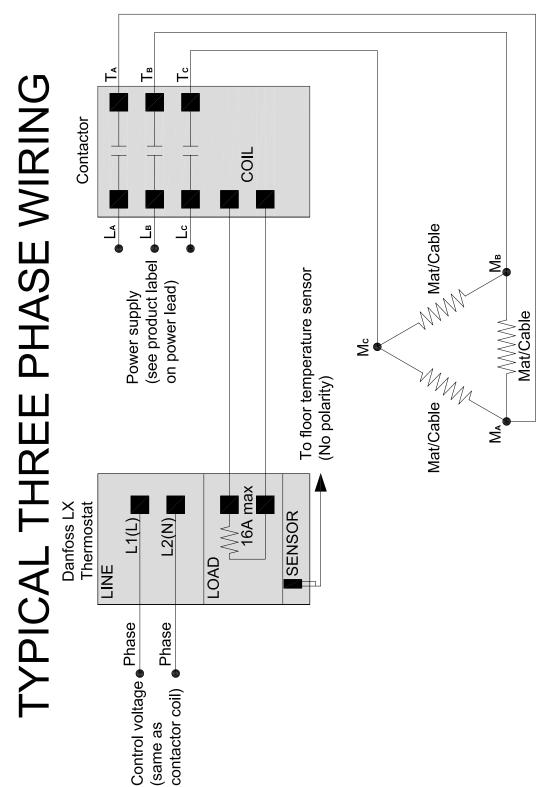
# Load Load TYPICAL SINGLE PHASE WIRING Contactor COIL see product label To floor temperature sensor on power lead) Power supply (No polarity) 6A max Danfoss LX **Thermostat** SENSOR L2(N) LOAD LINE Phase Phase Control voltage contactor coil)

# NUTEN

- 1. Installation of a ground fault protection device is strongly recommended. Please check local code for requirements.
  - Connect the mat/cable power lead directly to the load terminals of the thermostat. In such a case, ground fault 2. If the total current draw is 16A or less, and the mat voltage is 208/240V then the contactor can be ommited. protection is provided by the thermostat's built-in GFCI.
    - 3. Only one floor sensor is required per thermostat.



### **APPENDIX A: TYPICAL DANFOSS TX WIRING DIAGRAM (CONTINUED)**



NOTES

- I. Installation of a ground fault protection device is strongly recommended. Please check local code for requirements.
  - segment should have similar current draws to if a balanced load is desired. 2. A minimum of 3 mats/cables is required for this wiring. The mats on each
    - 3. Only one floor sensor is required per thermostat.

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Danfoss Inc. Toronto Toll Free: 866-676-8062 Phone: 905-285-2050 Fax: 905-285-2055 www.LX.Danfoss.com

