



1 Fan coil controller TRA-F12x-A

Fan coil controller for 3-speed fans with on/off valves and two external inputs — standalone, BACnet MS/TP or Modbus.

1.1 General Description

The TRA-F12x-A is an electronic fan coil controller for room temperature control. It supports motorized valves and 1- or 3-speed fans in 2-pipe and 4-pipe fan coil units for heating or cooling. Additional inputs can be used for an external temperature sensor, room occupancy (motion) detection and other functions. The controller offers Comfort, Economy and Protection operating modes. The TRA-F121-A includes a MODBUS RTU and the TRA-F122-A a BACnet MS/TP interface. Both types can be easily integrated into a building automation system.

Typical application includes:

- Fan coil systems
 - 2-pipe fan coil (cooling or heating on/off valve)
 - 2-pipe fan coil with 3-point valve (cooling or heating valve)
 - 2-pipe fan coil and electric heater
 - 4-pipe fan coil (cooling and heating on/off valve)
- Floor heating systems (on/off or 3-point valve)
- Chilled/Heated ceilings or chilled beams systems (on/off or 3-point valve)

1.2 Features

- LCD display with backlight
- Room temperature control via built-in temperature sensor
- 2 configurable inputs temperature or digital
- 2 outputs for on/off and 3-point valve control
- 3 outputs for 1- or 3-speed fan control (automatically or manually)
- Comfort, Economy and Protection operating mode
- Display of current room temperature or temperature set point in °C or °F
- Display of outdoor temperature received from Modbus master
- Manual or automatic heating / cooling changeover
- Select operating mode via operating mode button on the controller
- Minimum and maximum limitation of room temperature set point
- Floor heating temperature limitation
- Key lock function
- BACnet MS/TP interface (TRA-F122 only)
- Modbus RTU interface (TRA-F121 only)
- Reload default settings for commissioning and control parameters

- 100...240 VAC operating voltage
- Flush mount on all 75x75x35mm wall mounting box or larger boxes
- Selection of application via parameter
- No data lost on power fail

1.3 Safety



DANGER! Safety advice

This device is intended for use as an operating controller. It is not a safety device. Where device failure could endanger human life or property, it is the responsibility of the customer, installer and system designer to add additional safety devices to prevent such a failure. Failure to observe the specifications and local regulations may damage equipment and endanger life and property. Tampering with the device or misapplication will void the warranty.

1.4 Types and Ordering

Product Name	Product No.	Description / Type	Size / Length	Weight
Controller				
TRA-F120-A	40-100273	Fan coil controller standalone	88 x 88 x 41 mm (3.5 x 3.5 x 1.6 in)	168 g (5.92 oz)
TRA-F121-A	40-100217	Fan coil controller with Modbus	88 x 88 x 41 mm (3.5 x 3.5 x 1.6 in)	168 g (5.92 oz)
TRA-F122-A	40-100310	Fan coil controller with BACnet	88 x 88 x 41 mm (3.5 x 3.5 x 1.6 in)	168 g (5.92 oz)
Installation box (optional)				
AMB-001	40-510009	Flush mounting installation box	80 x 80 x 40 mm (3.2 x 3.2 x 1.6 inch)	40g (1.41oz)
AMB-006	40-510101	Surface mounting installation box	82 x 82 x 36 mm (3.2 x 3.2 x 1.4 inch)	41g (1.44oz)
Passive temperature sensor with flying lead (NTC 10kΩ at 25 °C (77 °F))				
S-Tn10-2	40-200001	-	2 m (6 ft.) PVC cable	-
S-Tn10-6	40-200142	-	6 m (19 ft.) PVC cable	-
Passive temperature sensor for duct mounting (NTC 10kΩ at 25 °C (77 °F))				
SD-Tn10-12-2	40-200002	12 cm (4.7 inch) probe	2 m (6 ft.) PVC cable	-
SD-Tn10-20-2	40-200003	20 cm (7.8 inch) probe	2 m (6 ft.) PVC cable	-
SDB-Tn10-12-1	40-200124	12 cm (4.7 inch) probe	-	-
SDB-Tn10-20-1	40-200133	20 cm (7.8 inch) probe	-	-
Passive temperature sensor for contact mounting on pipes (NTC 10kΩ at 25 °C (77 °F))				
SC-Tn10-2	40-200095	-	2 m (6 ft.) PVC cable	-
SC-Tn10-6	40-200159	-	6 m (19 ft.) PVC cable	-
Passive temperature sensor for indoor mounting (NTC 10kΩ at 25 °C (77 °F))				
SRA-Tn10	40-200005	Indoor temperature sensor	88 x 88 x 21 mm (3.5 x 3.5 x 0.8 inch)	-
Passive temperature sensor for outdoor mounting (NTC 10kΩ at 25 °C (77 °F))				
SOD-Tn10-1	40-200108	Outdoor temperature sensor	64 x 64 x 36 mm (2.5 x 2.5 x 1.4 inch)	-



Additional sensors and accessories can be found on the Vector Controls home page www.vectorcontrols.com.

2 Technical Specifications

Power supply	Power requirements	100...240 VAC, 50/60 Hz
	Power consumption	Max. 5 VA
	Electrical connection	Screw terminals Wire 0.15...2.05 mm ² (AWG 26...14)
Built-in sensor	Temperature range	0...50 °C (32...122 °F)
	Accuracy 0...50 °C	0.5 °C (1 °F)
Signal inputs	Digital and temperature input	Selectable via parameter
	Temperature range	-20...80 °C (-4...176 °F)
	Temperature accuracy	0.5 °C (1 °F) at 0...50 °C (32...122 °F) 1.0 °C (2 °F) at <0 °C (<32 °F), >50 °C (>122 °F)

	Type & range of temperature sensor	NTC (Sxx-Tn10): -40...140 °C (-40...284 °F)
Signal outputs	Relays outputs (SPST NO)	0...250 VAC, resistive load current 5A, inductive 2A
	Insulation strength between relays and system electronics	2500V to EN 60 730-1
	Insulation strength between neighboring contacts	2500V to EN 60 730-1
	Electronic control type	2.B (micro-disconnection)
Temperature resolution	Displayed temperature	0.1 °C (0.5 °F)
	Set point	0.5 °C (1 °F)
Network	Hardware interface	RS485 in accordance with EIA/TIA 485
	Max nodes per network	247
	Max nodes per segment	128
	Conductor wire	Shielded Twisted Pair (STP) cable
	Impedance	100 – 130 Ω
	Galvanic isolation	The communication circuitry is isolated
	Network topology	According Modbus manual (Modbus over serial line)
	Recommended maximum length per chain	1200 m (4000 ft.)
Modbus TRA-F121-A	Communication standard	Modbus RTU (www.modbus.org)
	Default setting	38400 baud rate, even parity, 1 stop bit
	Communication speed (baud rate)	2400, 4800, 9600, 19200, 38400, 57600, 115200
	Modbus RTU protocol (8 data bits)	no parity – 1 or 2 stop bits; even or odd parity – 1 stop bit
BACnet TRA-F122-A	Communication standard	BACnet MS/TP
	Default setting	38400 baud rate
	Communication speed (baud rate)	9600, 19200, 38400, 57600, 76800, 115200
Environment	Operation	To IEC 721-3-3
	Climatic conditions	class 3K5
	Temperature	0...50 °C (32...122 °F)
	Humidity	<85 % RH non-condensing
	Transport & storage	To IEC 721-3-2 and IEC 721-3-1
	Climatic conditions	class 3K3 and class 1K3
	Temperature	0...50 °C (32...122 °F)
	Humidity	<95 % RH non-condensing
Standards	Mechanical conditions	class 2M2
	Safety class	II (IEC 61140)
	Degree of protection	IP30 to EN 60529
General	Material	Fire proof PC+ABS plastic (UL94 class V-0)
	Dimensions front part (H x W x D)	88 x 88 x 16 mm (3.5 x 3.5 x 0.6 in)
	Dimensions back part (H x W x D)	67 x 61 x 25 mm (2.6 x 2.4 x 1.0 in)
	Weight (including package)	250 g (8.81 oz)

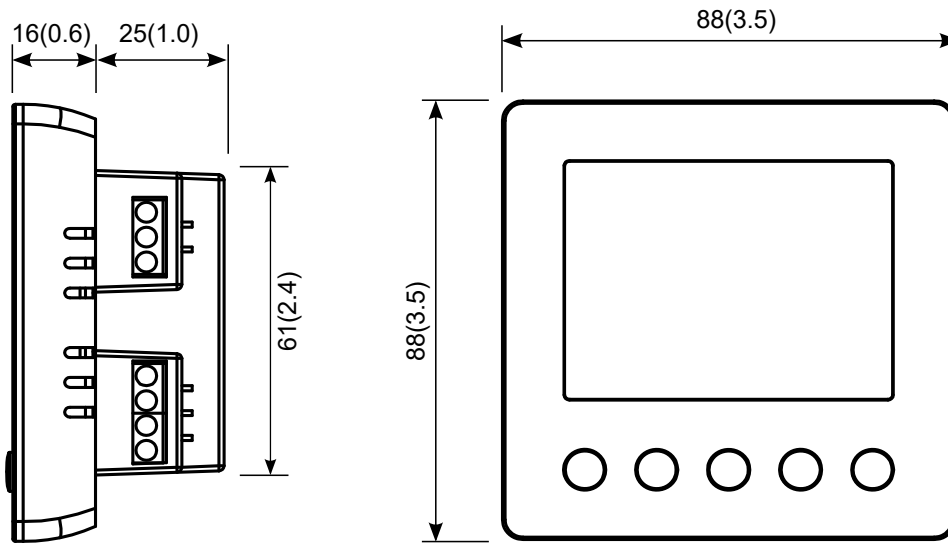
2.1 Product testing and certification



Declaration of
Conformity

Information on the conformity of our products can be found on our website
www.vectorcontrols.com on the corresponding product page under "Downloads".

2.2 Dimensions, mm (inch)



For flush mounting, a 75 x 75 x 35 mm (3.0 x 3.0 x 1.4 inch) installation box or larger must be used. See Ordering for recommended installation boxes (chapter 1.4, page 2).

2.3 Connection diagram

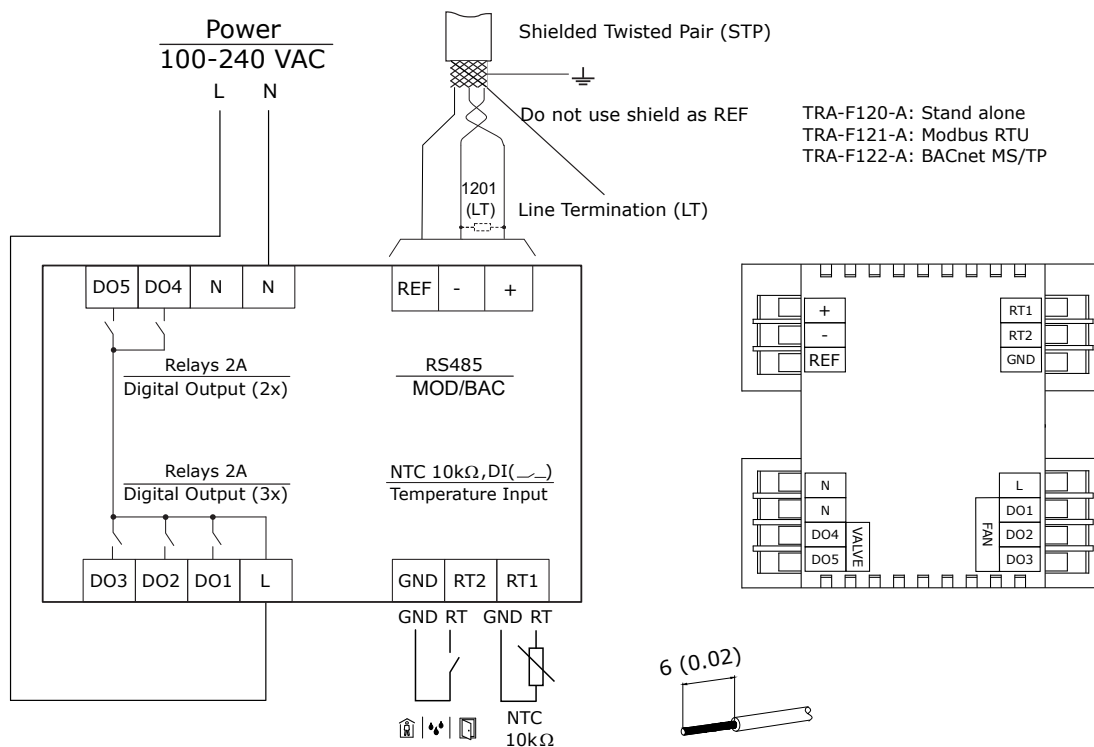


For details see the TRA-F12x-A installation sheet no. 70-000791 (www.vectorcontrols.com).



The wiring for the different predefined TRA-F12x-A applications can be found in chapter 5.6.3, page 18.

A typical connection of the TRA-F12x-A is shown below:



3 Operation

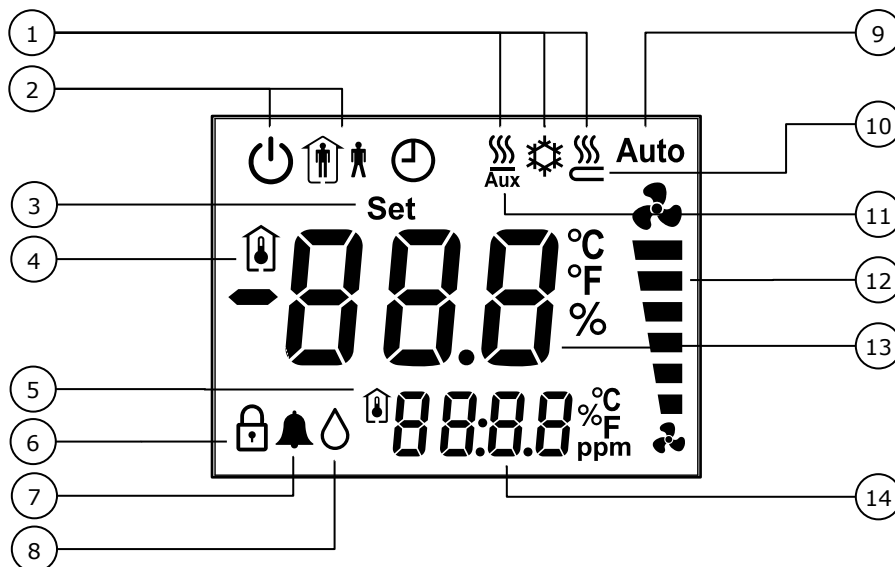
3.1 User interface



3.1.1 Button operation

Symbol	Function	Description
	Operating mode (Return)	Operating mode selection (Comfort Mode, Economy Mode, Protection Mode) Menu navigation: Return to top menu
	Controlling mode (Return)	Controlling mode selection (Heating Mode, Cooling Mode, Fan Only) Menu navigation: Return to top menu point Long press: Switch °C/ °F
	Down (-)	Adjust temperature set points and control parameters
	Up (+)	Adjust temperature set points and control parameters
	Fan (Enter, Save)	Change fan mode (auto mode or fan speed) Menu navigation: Enter menu point Parameter change: Save parameter Long press: Display external input status

3.2 LCD Display



1	Controlling Mode (see chapter 3.2.2)	8	Dew point alarm (see chapter 3.2.4)
2	Operating Mode (see chapter 3.2.1)	9	Fan auto mode
3	Set point or parameter setting active	10	Floor heating
4	Room temperature large digits	11	Electric heater
5	Room temperature small digits	12	Fan speed (low, medium, high)
6	Keys locked	13	Large digits (see chapter 3.2.3)
7	Alarm (see chapter 3.2.4)	14	Small digits (see chapter 3.2.3, 3.2.4, 3.2.5)

i ☹, % and ppm not used.

3.2.1 Operating modes

Display	Mode	Description
	Comfort (occupied)	The controller maintains the comfort temperature set point defined with parameter P300. In comfort mode, the fan can be set to auto or manual fan speed: Low, medium or high.
	Economy (unoccupied)	Controller maintains the economy temperature set points defined with parameter P301 and P302.
	Protection	The controller runs in standby. The system is protected against overheating and frost if enabled with parameter P303 and P304.

3.2.2 Controlling modes

Display	Mode	Description
	Heating	Heating mode activates heater for temperatures below set point. When the heating symbol is blinking, the heating valve is turned on. Also, the electric heater or floor heating symbols are blinking if the heating valve is turned on.
	Cooling	Cooling mode activates cooling equipment for temperatures above the set point. When the cooling symbol is blinking the cooling valve is turned on.
	Fan Only	The bars between the fan symbols show the fan speed (low, medium, high).

3.2.3 Large and small digits

The large digits show the measured room temperature (default setting) or the comfort temperature set point (configurable via parameter P101).

The small digits are off (default setting) or show the outdoor temperature (configurable via parameter P101). Also, alarms and error messages are shown on the small digits.

The room temperature and temperature set point are given in °C or °F (according to parameter P102).

3.2.4 Alarm messages

Alarm messages with alarm symbol are shown on the small digits.

Small Digits	LCD symbol		Alarm condition
ALA1		Alarm	Dew point alarm from input RT1/2 (parameter P500/P502 = 7)
		Dew point	
ALA2		Alarm	Overheat protection alarm (only in Protection mode)
ALA3		Alarm	Frost protection alarm (only in Protection mode)
ALA4		Alarm	Electric heater overheat alarm

3.2.5 Error messages

Error messages are shown on the small digits.

Small Digits	Error condition
Err1	Built-in temperature sensor error. Sensor is damaged (open or short circuit).
Err2	Temperature sensor RT1/RT2 error. The temperature sensor is not present. Verify wiring or parameter configuration. -99.9 is shown on large digits.
Err3	Digital input error. RT1/2 is not fully opened or closed (resistor between 1.25kΩ and 350kΩ). Verify wiring or parameter configuration.
Err4	Configuration error: A parameter is set in an invalid combination with another parameter. Err4 and one of the conflicting parameters are displayed alternating.
Err5	Time error: Set time and acknowledge error.

3.3 Temperature control

The controller measures room temperature with the built-in sensor or an external room temperature sensor and maintains the setpoint by controlling fan speed and the heating and/or cooling valve (or the electric heater). The following control outputs are available:

On/off valve

3-point valve (2-pipe systems only)

The switching differential or proportional band is 2 °C in heating mode and 1 °C in cooling mode (configurable via parameters P400 and P401).

The integral time defaults to 5 minutes (300 s) and is adjustable via parameter P402.

3.4 Controller operation

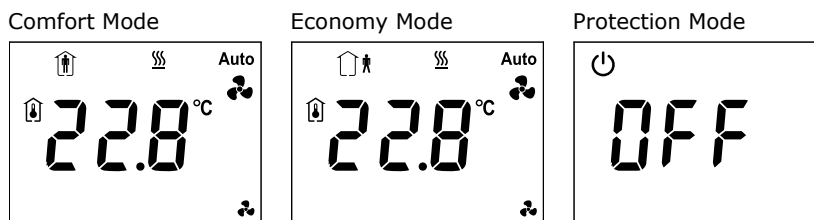


Enable or disable of economy mode and change of set point, fan speed, controlling mode or any user operation can be done via parameter settings (see parameter P104 to P108, default is ON and key lock disabled).

3.4.1 Operating mode

The controller operating mode can be switched between **Comfort** and **Economy Mode** with the operating mode button (⏻).

The controller is switched to **Protection Mode** by pressing the operating mode button (⏻) for 2 seconds.



If Economy mode is disabled (see parameter P103), the controller operating mode is switched between Comfort and Protection mode with the operating mode button (⏻).

Comfort Mode

In Comfort mode, the controller measures the room temperature via built-in sensor or external room temperature sensor and maintains the temperature of the Comfort set point by controlling the fan speeds and the heating and/or cooling valve (or the electric heater).

Economy Mode

In Economy mode, the controller measures the room temperature via built-in sensor or external room temperature sensor and maintains the temperature of the Economy set point by controlling the fan speeds and the heating and/or cooling valve (or the electric heater).

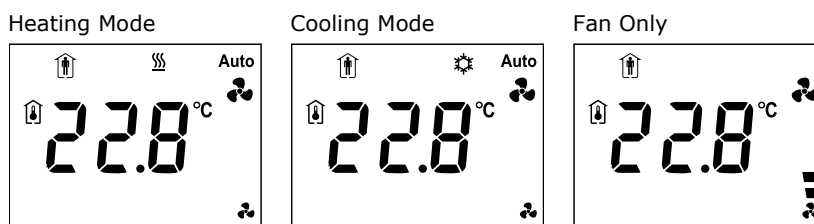
The temperature of the Economy set point depends on the controller configuration (see parameter P301 and P302).

Protection Mode

In Protection mode, the system is protected against frost (default 5 °C, see parameter P304) and protected against overheating (default OFF) (see parameter P303).

3.4.2 Controlling Mode

The controlling mode of the controller can be switched between **Heating Mode**, **Cooling Mode** and **Fan Only** by pressing the controlling mode button (⏻).



Depending on the configured application (see parameter P200), cooling or heating can't be selected as controlling mode.

Heating Mode

In heating mode, the controller measures room temperature with the built-in sensor or an external room temperature sensor and maintains the requested temperature (Comfort, Economy or manual setpoint) by controlling fan speed and the heating valve (or the electric heater).

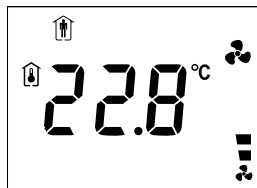
Cooling Mode

In cooling mode, the controller measures room temperature with the built-in sensor or an external room temperature sensor and maintains the requested temperature (Comfort, Economy or manual setpoint) by controlling fan speed and the cooling valve.

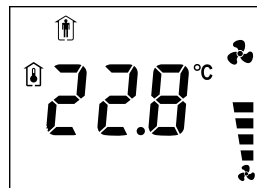
Fan Only

In fan only mode, the fan speed can be set with the up (Δ) or down (∇) button. Heating or cooling is deactivated.

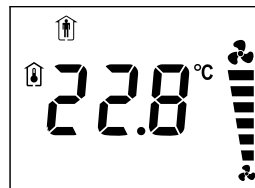
Fan Only (low)



Fan Only (medium)



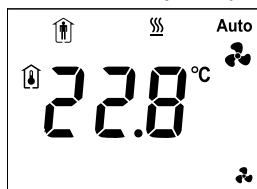
Fan Only (high)



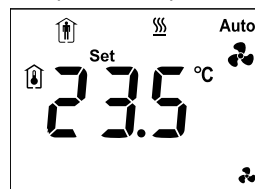
3.4.3 Temperature control

The comfort temperature set point can be adjusted in 0.5 °C (1 °F) steps with the up (Δ) and down (∇) button and saved either with the operating mode button ($\odot$), the controlling mode button ($\odot$) or the fan button (). The Set symbol is shown on the display while changing the temperature.

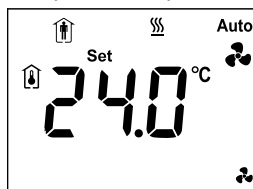
Confort mode (example)



Temperature up



Temperature up

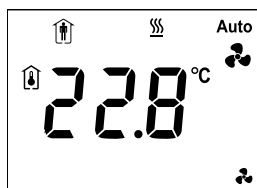


If the Economy mode is active, pressing the up (Δ) or down (∇) button will change the controller into the confort mode.

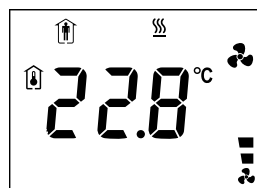
3.4.4 Fan speed

The fan speed can be changed between auto, low, medium and high fan speed by pressing the fan button ().

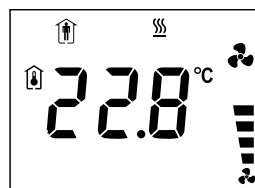
Fan auto



Fan low



Fan medium



Fan high



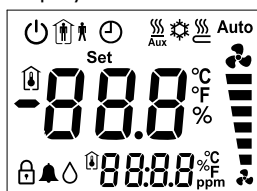
3.4.5 Controller start up

Normal start-up

During start-up, the display backlight and all LCD segments are shown for two seconds. The software version and revision are then shown for two seconds on the small digits (format 1r0 = version 1, revision 0).

On the TRA-F121-A and TRA-F122-A, the address of the controller is also shown for two seconds.

Display test



Software version (example)



Communication address (example)

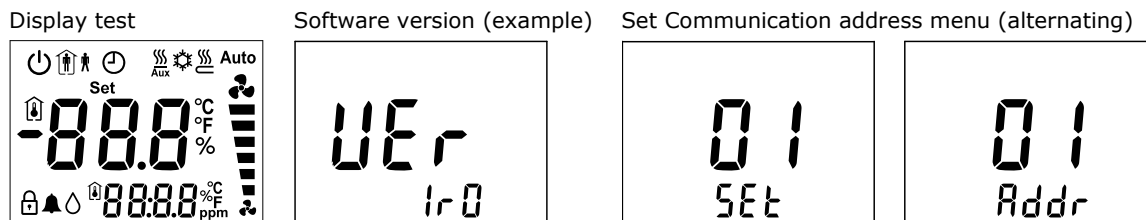


Start-up when the communication address is not set (after initial installation)

During start-up, the display backlight and all LCD segments are shown for two seconds. The software version and revision are then shown for two seconds on the small digits (format 1r0 = version 1, revision 0).

After the software version, the communication address can be set with the up (▲) or down (▼) button and stored with the fan (🌀) button.

To leave the menu without saving the communication address, press the operating- (⏻) or controlling mode (↺) button.



i If no address is entered, set mode is left automatically after 10 minutes. The address set menu will appear again on the next start-up.

After these steps the controller runs in comfort, economy or protection mode.

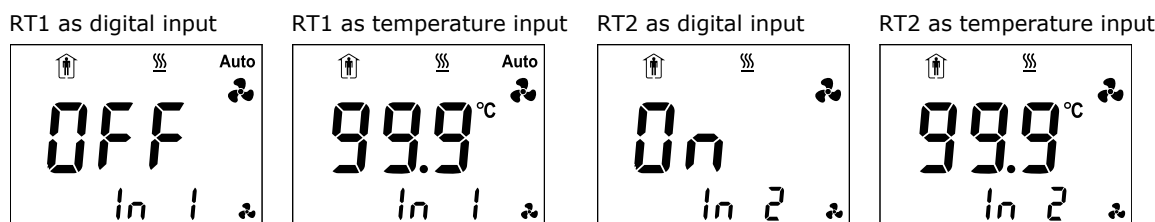
3.4.6 Power Failure

All temperature set points and parameters are automatically saved and do not need to be re-entered.

Upon return of power, the controller will start in Protection, Comfort or the same mode, according to the controller configuration (see parameter P110).

3.5 View input status (RT1/RT2)

Press the fan button (🌀) for minimum 3 seconds to enter the input menu. The input status of RT1 and RT2 is displayed in alternation.



The status of the inputs is displayed:

Condition	Large digits show	Small digits show
RT1 configured as NO/NC digital input	on/off	In 1
RT1 configured as NTC temperature sensor	Temperature in °C/ °F	In 1
RT2 configured as NO/NC digital input	on/off	In 2
RT2 configured as NTC temperature sensor	Temperature in °C/ °F	In 2

Press the Operating (⏻) or Controlling (↺) Mode button to leave the menu. After one minute the input menu is left automatically.

4 Installing the controller

4.1 Mounting and installation



For details see the TRA-F12x-A installation sheet no. 70-000791 (www.vectorcontrols.com).

4.2 Sealing of cable entries



Important!

All cable entries into the connection box must be sealed to prevent air drafts, which could otherwise affect the sensors in the device and prevent correct measurements!

4.3 Selection of actuators and sensors

Temperature sensors:

Use Vector Controls NTC sensors to achieve maximum accuracy, see ordering list in chapter 1.4, page 2.

Binary auxiliary devices (e.g. fans, on/off valves, etc.):

Do not directly connect devices that exceed specified limits in technical specifications – observe startup current on inductive loads.

4.4 Electrical connection of external inputs

Use only twisted pair copper conductors for input connections. The operating voltage must comply with the requirements for safety extra-low voltage (SELV) as per EN 60 730.

4.5 Power Failure

All temperature set points and parameters are automatically saved and do not need to be re-entered.

4.6 Communication wiring

This chapter only applies for communicating devices TRA-F121-A and TRA-F122-A.

4.6.1 Wire type

An EIA-485 network shall use shielded, twisted-pair cable for data signaling with characteristic impedance between 100 and 130 Ω . Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot). Distributed capacitance between conductors and shield shall be less than 200 pF per meter (60 pF per foot). Foil or braided shields are acceptable.

4.6.2 Line termination

On last node on either end of the bus connect a 120 Ω termination resistor between (+) and (-).

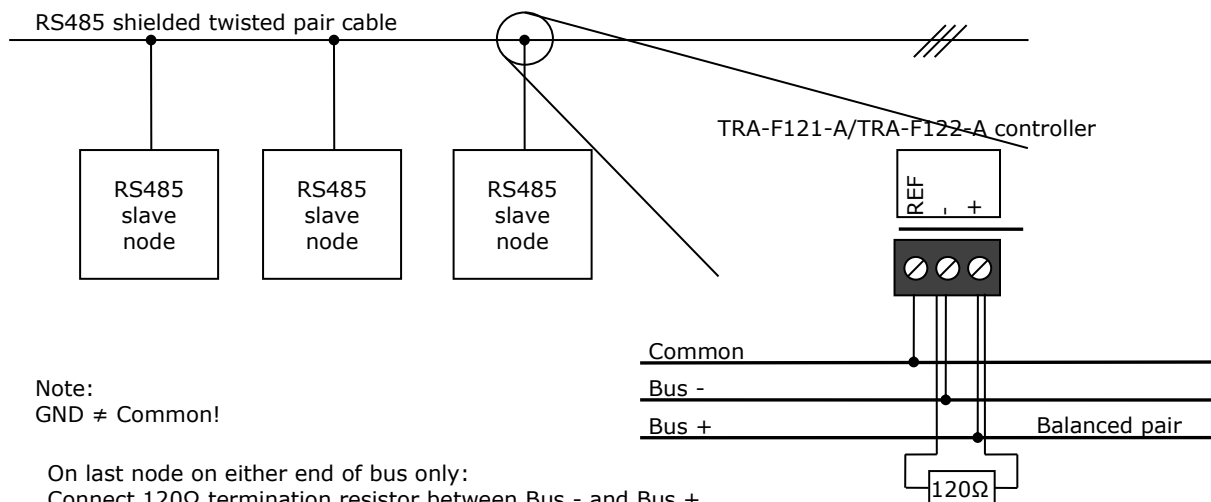
4.6.3 Maximum length

The maximum recommended length per segment is 1200 meters (4000 feet) with AWG 18 (0.82 mm²) conductor area cable.

4.6.4 Shield connection

See ASHRAE Standard 135 for detailed recommendation regarding how to connect the shield depending on type of nodes present in the network.

4.6.5 Communication wiring



5 Configuration (parameter options)

5.1 Setting controller parameter with user interface

5.1.1 Entering the password protected parameter menu

1. Press the up (Δ) and down (∇) button for at least 3 seconds.
2. The software version is displayed.
3. To continue to the password menu, press either the up (Δ), down (∇) or fan button ($\clubsuit$).
4. Enter the code **241** with the up (Δ) or down (∇) button.
5. Confirm the code with the fan button ($\clubsuit$).

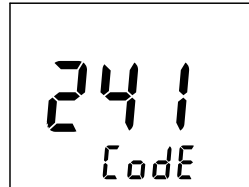
Software version (example)



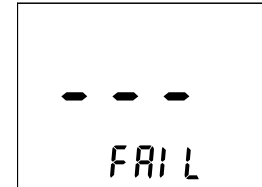
Password



Password entered



Password not valid



5.1.2 Setting parameters

1. Press the up (Δ) or down (∇) button to select the desired parameter.
2. To set the value of parameter, press the fan button ($\clubsuit$) then adjust the value with the up (Δ) or down (∇) button and save the setting by pressing the fan button ($\clubsuit$) again.

5.1.3 Exit the parameter menu

Press the Operating ($\odot$) or Controlling ($\odot$) Mode button to leave the parameter menu.

5.1.4 Display of large parameter values

For parameter values greater than 1000, the large and small digits are swapped in the parameter menu: the large digits show the parameter number and the small digits show the value.

5.2 Modbus settings (TRA-F121-A only)

5.2.1 Parameter number, resolution and data format

Parameter number and Modbus data address are the same. They are listed as decimal numbers in the Par/Addr column.

Example: P001 is parameter 001 and has Modbus data address 1.

All temperature-related parameters are transferred in $^{\circ}\text{C}$ via Modbus. Values can be displayed in $^{\circ}\text{F}$ on the user interface only. Parameters without a multiplier have a resolution of 1. Parameters with multiplier 10 have a resolution of 0.1.

Example: the default Comfort temperature setpoint (P300) is 20.0°C . The value read via Modbus is 200, because multiplier 10 is used for P300.

The multiplier applies only to Modbus data access. On the user interface, values are shown in normal resolution.

Parameters with values below 0 are transferred as signed integers.

5.2.2 Modbus function code

The controller supports the following Modbus function codes:

Modbus function code	Data
Read multiple register (0x03)	Read n registers (n x 2 bytes) starting from requested address.
Write register (0x06)	Write 1 register (2 bytes) at requested address.
Write multiple registers (0x10)	Write n register (n x 2 bytes) starting from sent address.

Note: The read/write capability of each parameter is defined in column "R/W". Most parameters can be read and written defined as "R/W". Read only parameters are defined as "R".

5.2.3 Parameter P00x overview

Each Modbus slave device needs a unique device address (ID) in the network. It can be set with P001. All other Modbus network properties can be set with parameter P002, P003 and P006.

With parameter P005 the write access to the parameter via Modbus master is disabled (except P005 can always be written).

Par/Addr	Description	Data type / value	Default	R/W
P001	Modbus device address (ID)	Address range: 1...247	1	R/W
P002	Baud Rate Modbus RS485	0 = 2400 BPS 1 = 4800 BPS 2 = 9600 BPS 3 = 19200 BPS 4 = 38400 BPS 5 = 57600 BPS 6 = 115200 BPS	4	R/W
P003	Parity and stop bits	0 = NO Parity, 2 stop bits 1 = EVEN Parity, 1 stop bit 2 = ODD Parity, 1 stop bit 3 = NO Parity, 1 stop bit	1	R/W
P004	Mode of communication	Not used (always 1 = RTU)	1	R
P005	Allow changing of parameter settings through communication	0 = Not allowed (except P005) 1 = Allowed	1	R/W
P006	Modbus address PLC style	0 = No offset 1 = PLC address style (+1 address offset)	0	R/W

5.3 BACnet settings (TRA-F122-A only)

5.3.1 Parameter number, resolution and data format

Parameter number and BACnet object ID are the same. They are listed as decimal numbers in the Par/Addr column.

Example: P000 is parameter 000 and is BACnet object MV 00.

All temperature-related parameters are transferred in °C or °F via BACnet depending on the setting of the controller. All parameters are shown according to their value without the need of multipliers.

5.3.2 Parameter P00x overview

Each BACnet device needs a unique device address (ID) in the network. It can be set with P001. All other Modbus network properties can be set with parameter P002, P003 and P006.

With parameter P005 the write access to the parameter via Modbus master is disabled (except P005 can always be written).

Par/Addr	Description	Data type / value	Default	R
P001	Communication address (must be unique in network)	Address range: 1...127	1	R/W
P002	Baud Rate Modbus RS485	0 = 2400 BPS 1 = 4800 BPS 2 = 9600 BPS 3 = 19200 BPS 4 = 38400 BPS 5 = 57600 BPS 6 = 115200 BPS	4	R/W
P003	Highest master	Range: 1...127	127	R/W
P004	Max Info Frames	Range: 1...5	1	R/W
P005	Send I am at boot	0 = OFF, 1 = ON	1	R/W
P006	Allow changing of parameter settings through communication	0 = Not allowed (except P006) 1 = Allowed	1	R/W
P007	Device object ID1 (abbccdd)	0-9999	0	R/W
P008	Device object ID2 (abbccdd)	0-419	1	R/W

The device object name is auto built to TRA-F122A-"device object ID". The default name is "TRA-F122A-10000", according to above default parameters.

5.4 Operating options

5.4.1 Parameter P1xx overview

With parameter P100 – P102 the displayed content can be set.

With parameter P104 – P109 the access via user interface can be restricted.

With P103 the Economy mode can be disabled (default is enabled).

With P110 the controller state after power failure can be set.



When P102 is set to °F, only the user interface values are displayed in °F. The values in the parameter menu are always in °C.

Par/Addr	Description	Data type / value	Default	R/W
P100	Standard temperature display (large digits)	0 = Room temperature (built-in sensor or external NTC on RT1/2) 1 = Set point of running operating mode	0	R/W
P101	Display on small digits	0 = No display 1 = Outdoor temperature (via Modbus/BACnet)	0	R/W
P102	Selection of temperature unit	0 = °C 1 = °F	0	R/W
P103	Enable Economy mode	0 = OFF = Economy mode disabled 1 = ON = Economy mode enabled	1 = ON	R/W
P104	Enable temperature unit change with button (long press)	0 = OFF = Changing disabled 1 = ON = Changing enabled	1 = ON	R/W
P105	Enable change of temperature set points via user interface	0 = OFF = Change of set points disabled 1 = ON = Change of set points enabled	1 = ON	R/W
P106	Enable manual control of fan speeds via user interface	0 = OFF = Manual control of fan speeds via user interface disabled 1 = ON = Manual control of fan speeds via user interface enabled	1 = ON	R/W
P107	Enable manual control of heat/cool/fan only via user interface	0 = OFF = Manual control of heat/cool/fan only disabled 1 = ON = Manual control of heat/cool/fan only enabled	1 = ON	R/W
P108	Key lock (No button operation)	0 = Disabled 1 = Keys locked (Press 5 sec Up (▲) and Down (▼) button, then 5 sec Operating (⏻) and Controlling Mode buttons (↻) to unlock. After 5min without user action the buttons are locked again.)	0	R/W
P109	Enable all parameter for user interface (P001 to P506)	0 = OFF = Parameters can only be changed from Modbus/BACnet 1 = ON = Parameters can be changed from user interface	1	R/W
P110	State after power failure	0 = Protection mode (OFF) 1 = Comfort mode (ON) 2 = State before power failure	2	R/W
P111	Enable parameter (P103-P107) scope	0 = Enable parameters (P103-P107) only valid for user interface 1 = Enable parameters (P103-P107) valid for user interface and Modbus/BACnet interface	0	R/W

5.5 Quick system and output configuration (application specific)

A set of predefined system and output parameters allows for easy selection of a typical TRA application.

With P000, it is possible to select from a set of predefined configurations.

Using a predefined configuration will override some of the affected P200, P201 and P203 parameters accordingly.

If one of the preset P200, P201 or P203 parameters is changed, P000 will be reset to 0.

Par/Addr	Description	Data type / value	Default	R/W
P000	Use a predefined application configuration	Range: 0...19	0	R/W

5.5.1 Parameter P000 overview

The following predefined system configurations are available:

P000 value	Description of predefined system configurations (application)
0	Default TRA application
1	2-pipe heating only, on/off valve, 3 stage fan
2	2-pipe cooling only, on/off valve, 3 stage fan
3	2-pipe manual heating or cooling, on/off valve, 3 stage fan
4	2-pipe automatic heating or cooling, on/off valve, 3 stage fan, changeover sensor at RT1
5	2-pipe heating only, 3-point valve, 3 stage fan
6	2-pipe cooling only, 3-point valve, 3 stage fan
7	2-pipe manual heating or cooling, 3-point valve, 3 stage fan
8	2-pipe automatic heating or cooling, 3-point valve, 3 stage fan, changeover sensor at RT1
9	2-pipe cooling only with electric heater, on/off valve, 3 stage fan
10	4-pipe manual heating or cooling, on/off valve, 3 stage fan
11	4-pipe auto heating or cooling, 3 stage fan, RT1 as digital changeover input (NO)
12	4-pipe heating and cooling, 3 stage fan
13	Floor heating, on/off valve
14	Floor heating, 3-point valve
15	Chilled ceiling, 3-point valve
16	Chilled ceiling, on/off valve
17	Chilled ceiling, on/off valve, electric heater
18	Heated/chilled ceiling, on/off valve
19	Heated/chilled ceiling, 3-point valve



Depending on the desired functionality of the TRA control, additional configuration may be required.



A detailed description of the system and output configuration can be found in chapter 5.6 System and output configuration, page 16.

5.5.2 Application modes: Wiring diagrams of outputs



An overview of the of the application specific output wiring diagrams can be found in chapter 5.6.3, page 18.

5.6 System and output configuration

5.6.1 Parameter P2xx overview

With parameter P200 – P203 the installed application and valve type can be selected.

With parameter P204 – P206 the valve characteristics can be set.

With parameter P207 – P214 the fan configuration can be set.

Par/Addr	Description	Data type / value	Default	R/W
P200	Application mode: 2-pipe system: 0...3 4-pipe system: 4...6	0 = Heating only 1 = Cooling only 2 = 2-pipe manual heating or cooling 3 = 2-pipe auto heat/cool changeover 4 = 4-pipe manual heating or cooling 5 = 4-pipe auto heat/cool changeover 6 = 4-pipe Heating and cooling 7 = Floor heating system 8 = Chilled ceiling system 9 = Heated/chilled ceiling system 10 = 4-pipe heated/chilled ceiling system	0	R/W
P201	Enable electric heater	0 = OFF = Electric heater disabled 1 = ON = Electric heater enabled	0 = OFF	R/W
P202	Fan extension time after electric heating	0...600 sec	60 sec	R/W
P203	Valve type of heating/cooling system	0 = on/off valve 1 = 3-point valve (only for 2-pipe systems) 2 = 2-position valve (only for 2-pipe systems)	0	R/W
P204	3-point valve running time	20...500 sec	150 sec	R/W
P205	Minimum on time of valve for on/off type	0...30 min	1 min	R/W
P206	Minimum off time of valve for on/off type	0...30 min	1 min	R/W
P207	Number of fan speeds	1 = 1 fan speed (only DO1) 3 = 3 fan speeds	3	R/W
P208	Minimum on time of each fan speed	10...600 sec	120 sec	R/W
P209	Low fan speed switch on level (Switch off level 15% lower or 0%) Note: Ignored for on/off valve (and electric heater), see chapter 5.8 Control settings	0...25 %	10 %	R/W
P210	Medium fan speed switching point (Switch off level 15% lower)	30...75 %	60 %	R/W
P211	High fan speed switching point (Switch off level 15% lower)	80...100%	100 %	R/W
P212	Fan kick period	0 = OFF = Fan kick disabled 5...1500 = period in minutes	0 = OFF	R/W
P213	Minimum fan speed in auto mode	0 = Fan off 1 = Low speed	0	R/W
P214	Minimum fan speed in manual mode	0 = Fan off 1 = Low speed	1	R/W
P215	Maximum fan speed in economy mode	1 = Fan speed 1 2 = Fan speed 2 3 = Fan speed 3	3	R/W

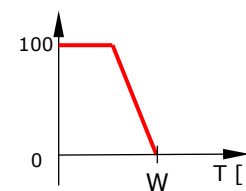
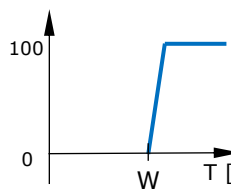
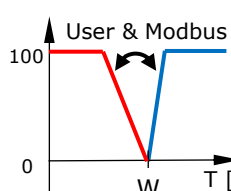
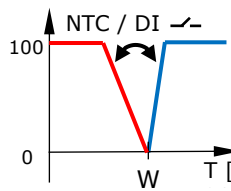
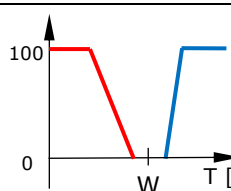
5.6.2 Application modes: Valve control diagrams

Detailed explanation of Comfort and Economy temperature set points are given in chapter 5.7 Set points, page 21.

Detailed explanation of on/off or 3-point valve control are given in chapter 5.8 Control settings, page 23.

Detailed explanation of auto heat/cool changeover are given in chapter 5.9 Temperature and digital inputs, page 26.

Affected Parameters	Parameter Description
P200	Application mode

Application mode	P200 setting	Valve control diagram (comfort mode)
2-pipe system Heating only	0	 W: Comfort set point
Floor heating system	7	
2-pipe system Cooling only	1	
Chilled ceiling system	8	
2-pipe system manual heating or cooling	2	 User & Modbus
4-pipe system manual heating or cooling	4	
Heated/chilled ceiling	9	
2-pipe system auto heat/cool changeover	3	
4-pipe system auto heat/cool changeover	5	
4-pipe system Heating and cooling	6	

5.6.3 Application modes: Wiring diagrams of outputs

Affected Parameters	Parameter Description		
P200	Application mode		
P201	Enable electric heater		
P203	Valve type of heating/cooling system		

System	P000 predefined settings	P200, P201, P203 settings	Wiring diagram of outputs
2-pipe system - on/off valve - DO4: Heating or cooling	1 = Heating only 3-stage fan 2 = Cooling only 3-stage fan 3 = Manual heating or cooling 3-stage fan 4 = Automatic heating or cooling 3-stage fan	P200 0, 1, 2 or 3 P201 0 = OFF P203 0 = on/off valve	
2-pipe system 3-point valve - Heating or cooling - DO4 open valve - DO5 close valve	5 = Heating only 3-stage fan 6 = Cooling only 3-stage fan 7 = Manual heating or cooling 3-stage fan 8 = Automatic heating or cooling 3-stage fan	P200 0, 1, 2 or 3 P201 0 = OFF P203 1 = 3-point valve	
2-pipe system cooling only with electric heater - on/off cooling valve - DO4: Cooling - DO5: Electric Heater	9 = Cooling with electric heater 3-stage fan	P200 1 = Cooling only P201 1 = ON = Electric heater enabled P203 0 = on/off valve	
4 pipe system - on/off valve - Heating and/or cooling - DO4: Cooling - DO5: Heating	10 = Manual heating or cooling 3-stage fan 11 = Auto heating or cooling RT1 as normally open DI 3-stage fan 12 = Heating and cooling 3-stage fan	P200 4, 5 or 6 P201 0 = OFF P203 0 = on/off valve	
- Floor heating system - on/off valve - DO4: Heating	13 = Floor heating On/off valve	P200 7 = Floor heating system P201 0 = OFF P203 0 = on/off valve	

System	P000 predefined settings	P200, P201, P203 settings	Wiring diagram of outputs
- Floor heating / chilled ceiling system 3-point valve - DO4 open valve - DO5 close valve	14 = Floor heating 3-point valve 15 = Chilled ceiling 3-point valve	P200 7, 8 or 9 P201 0 = OFF P203 1 = 3-point valve	
- Chilled ceiling system - DO4: Cooling - DO5: Electric heater (optional)	16 = Chilled ceiling On/off valve 17 = Chilled ceiling On/off valve Electric heater	P200 8 = Chilled ceiling system P201 0 or 1 (optional electric heater) P203 0 = on/off valve	
- Heated/chilled ceiling system •DO4: Heating/Cooling	18 = Heated/chilled ceiling On/off valve	P200 9 = Heated/chilled ceiling system P201 0 = OFF P203 0 = on/off valve	

5.6.4 Manual vs. auto heat/cool change

Manual heating or cooling allows the user interface (via Controlling Mode button ) and Modbus master to change between heating and cooling. No input (RT1/2) can use the function "Heat/cool changeover" (P500/P502 = 2).

To allow only Modbus master control the heat/cool state parameter, P107(Enable manual control of heat/cool/fan only) must be set to 0 = OFF. Modbus master can control the Controlling mode (heat/cool/fan only) with controller runtime data D1101.

Auto heat/cool changeover allows one of the inputs (RT1/2, where RT1 has higher priority) to act as a control input for heat/cool changeover. See chapter 5.9 Temperature and digital inputs, page 26. User interface and Modbus master control of heat/cool change are disabled in auto heat/cool application (P200 = 3 or 5). Via user interface the user can only change to fan only.

5.6.5 3-point valve control

Output DO4 provides the OPEN command, output DO5 provides the CLOSE command to the 3-point valve. The default setting for the valve running time is 150 seconds. It can be adjusted via parameter P204.

Valve synchronization:

- After power up the CLOSE command (DO5) is on for two times the valve running time (P204).
- When the control output is <5%, the CLOSE command (DO5) is on for an additional valve running time.
- When the control output is >95%, the OPEN command (DO4) is on for an additional valve running time.

5.6.6 2-position valve control

Output DO4 provides the OPEN command, output DO5 provides to CLOSE command to the 2-position hydronic valve. DO4 stays ON whenever the valve needs to be open, DO5 stays ON whenever the valve needs to be closed. As this valve has a very short running time, a partially open state is not supported.

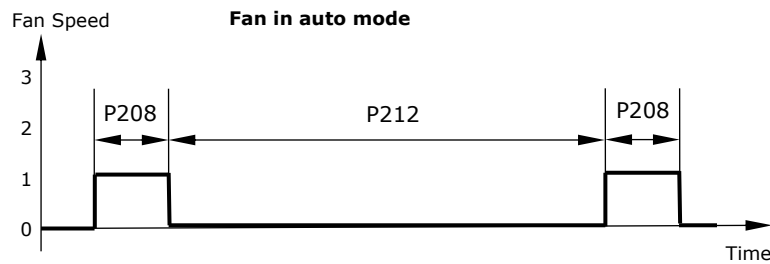
5.6.7 Fan extension time for electric heater

When the electric heater is switched off, the fan keeps running for the time specified with P202 to avoid over-heating of the electric heater.

5.6.8 Periodic fan kick

The periodic fan kick is disabled by default settings.

In automatic fan mode, if the fan speed is 0, the fan will be set to fan speed 1 periodically with the time defined with P212. The fan runs after this period for the minimum on time for fan speeds (P208).



5.6.9 Floor heating system with or without floor temperature limitation

Detailed explanation of floor temperature limitation is given in chapter 5.9 Temperature and digital inputs, page 26.

The floor heating system can be configured with or without floor temperature limitation.

Parameter setting...	with floor temperature limitation	without floor temperature limitation
P200 (Application Mode)	7 = Floor heating system	7 = Floor heating system
P500/P502 (Input RT1/RT2 Configuration)	2 = Heat/cool changeover or floor temperature sensor (NTC or DI)	Not 2 (0 - 1, 3 - 7)
P501/P503 (Definition of RT1/ RT2)	0 = NTC temperature sensor	X
P505 (Floor temperature limit)	Set limitation (Default: 30 °C/86 °F)	Ignored

5.7 Set points

5.7.1 Parameter 3xx overview

Par/Addr	Description	Data type / value	Default	R/W
P300	Comfort temperature set point	Multiplier: 10 10.0...70.0 °C (50.0...158.0 °F)	20.0 °C (68.0 °F)	R/W
P301	Economy temperature set point in Heating mode Heating temperature set point < Cooling temperature set point	Multiplier: 10 10.0...25.0 °C	15.0 °C	R/W
P302	Economy temperature set point in Cooling mode Cooling temperature set point > Heating set point	Multiplier: 10 20.0...40.0 °C	30.0 °C	R/W
P303	Overheat protection temperature point	Multiplier: 10; Integer (signed) 25.0...45.0 °C -0.1 = OFF	-0.1 = OFF	R/W
P304	Frost protection temperature point	Multiplier: 10; Integer (signed) 0.0...16.0 °C -0.1 = OFF	5.0 °C	R/W
P305	Minimum temperature set point limit in heating mode	Multiplier: 10 10.0...70.0 °C	16.0 °C	R/W
P306	Maximum temperature set point limit in heating mode	Multiplier: 10 10.0...70.0 °C	30.0 °C	R/W
P307	Minimum temperature set point limit in cooling mode	Multiplier: 10 10.0...70.0 °C	14.0 °C	R/W
P308	Maximum temperature set point limit in cooling mode	Multiplier: 10 10.0...70.0 °C	28.0 °C	R/W

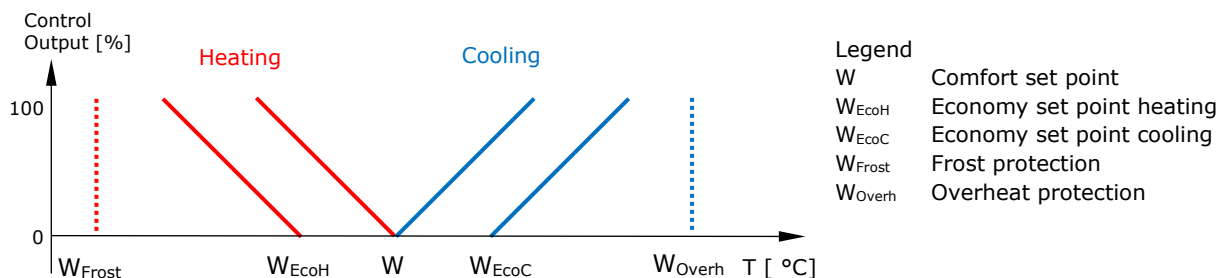
5.7.2 Temperature set point types

There are several set points with different functionalities.

The default temperature set point is the Comfort set point P300. This set point may be directly changed by the user on the user interface. It is active during Comfort Mode.

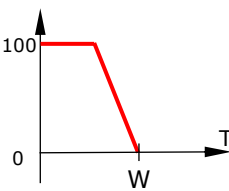
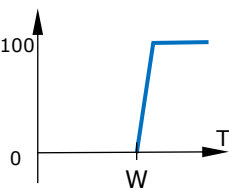
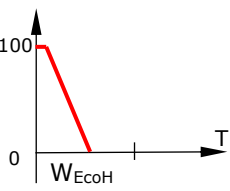
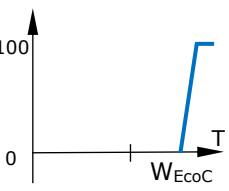
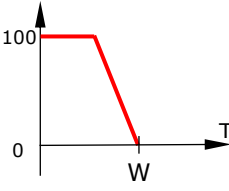
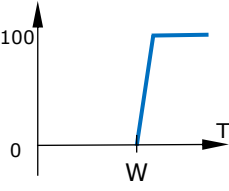
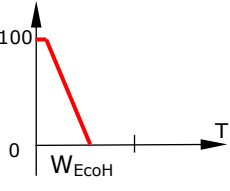
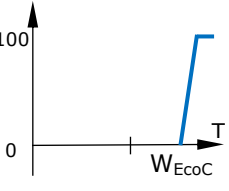
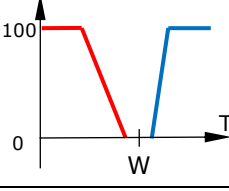
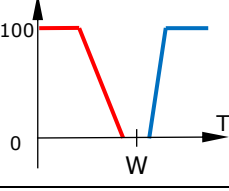
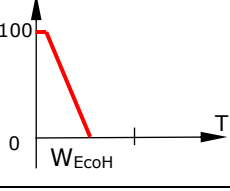
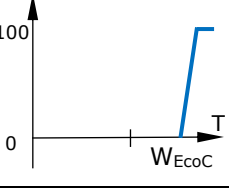
In Economy mode the economy temperature set point is active (economy heating set point P301 in heating mode and economy cooling set point P302 in cooling mode).

For protection of the facility, overheat protection temperature set point P303 and frost protection temperature set point P304 can be defined. In default settings, overheat protection is disabled.



Note 1: If enabled, frost protection and overheat protection are only active in Protection mode.

Note 2: Comfort set point is not compared with economy heating/cooling set point, nor with frost/overheat protection set points. Economy set points are not compared with frost/overheat protection set points.

Application	Comfort mode		Economy mode	
	Heating	Cooling	Heating	Cooling
2-pipe system Heat only, Cool only, Heat or cool (P200 = 0, 1, 2, 3)				
4-pipe system Heat or cool (P200 = 4, 5)				
4-pipe system Heat and cool (P200 = 6)				

The controller acquires the room temperature via built-in sensor or external temperature sensor and maintains the temperature set point by delivering actuator control commands to heating and/or cooling equipment.

5.8 Control settings

5.8.1 Parameter 4xx overview

Par/Addr	Description	Data type / value	Default	R/W
P400	Heating mode on/off valve: Switching differential (X_H) 3-point valve: Proportional band (X_{pH}) See P203 for valve type	Multiplier: 10 0.1...10.0 °C	2.0 °C	R/W
P401	Cooling mode on/off valve: Switching differential (X_C) 3-point valve: Proportional band (X_{pC}) See P203 for valve type	Multiplier: 10 0.1...10.0 °C	1.0 °C	R/W
P402	Integral time Note: For floor heating and chilled ceiling the integral action is 60 times slower	0 = Integral disabled 10 ... 1200 sec Floor heating: 10 ... 1200 min	300 sec Floor h.: 60 min	R/W
P403	Dead zone half span (in Comfort mode for cooling and heating application [P200 = 6])	Multiplier: 10 0.1...5.0 °C	1.0 °C	R/W

5.8.2 Proportional control (proportional band or switching differential)

The proportional control function calculates the output from the difference between the temperature setpoint and the measured room temperature. The proportional band (P-band) is the temperature difference required to produce a 100% output.

Example: in a heating sequence with a P-band of 2.0 °C, the output is 100% when the measured temperature is 2.0 °C below the setpoint.

The P-band is the inverse of the proportional gain. A small P-band gives a fast-reacting controller that is more prone to oscillation. A large P-band gives a slower-reacting controller.

5.8.3 Integral control (integral time)

The integral time is the time required for the integral action alone to produce the same change in the manipulated variable as the proportional action. The shorter the integral time, the stronger the integral correction.

$$out(t) = \frac{1}{X_{H/C}} (e(t) + \frac{1}{T_i} \int_0^t e(\tau) d\tau)$$

$out(t)$ = Control Output (heat or cool)

$e(t)$ = setpoint(t) – temperature(t)

$X_{H/C}$ = proportional band or switching differential (heat or cool)

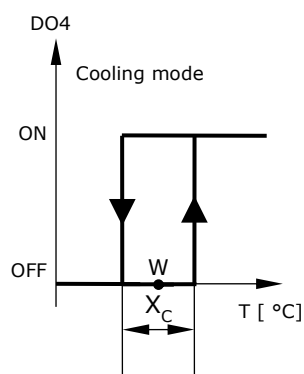
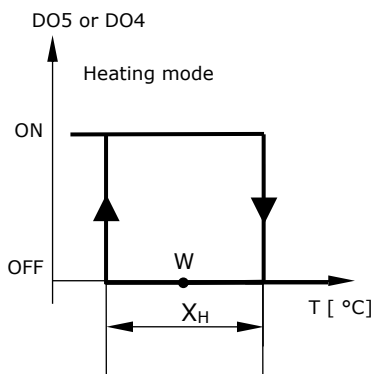
T_i = integral time

The integral time can be set between 10 and 1200 seconds (20 minutes). The default value is 300 seconds (5 minutes). For room temperature control, the integral time should be set to more than 120 seconds (2 minutes), because the room temperature needs several minutes to respond after the heating or cooling valve position has changed.

5.8.4 on/off control

The diagrams show the on/off control sequence for all applications except 4-pipe heating and cooling (P200 = 4) which is explained below.

Parameters	Parameter Description	Valid values for given chart
P200	Application mode	Not 6 (0 - 5, 7 - 8)
P201	Enable electric heater	0 or 1
P203	Valve Type	0 (= on/off valve)

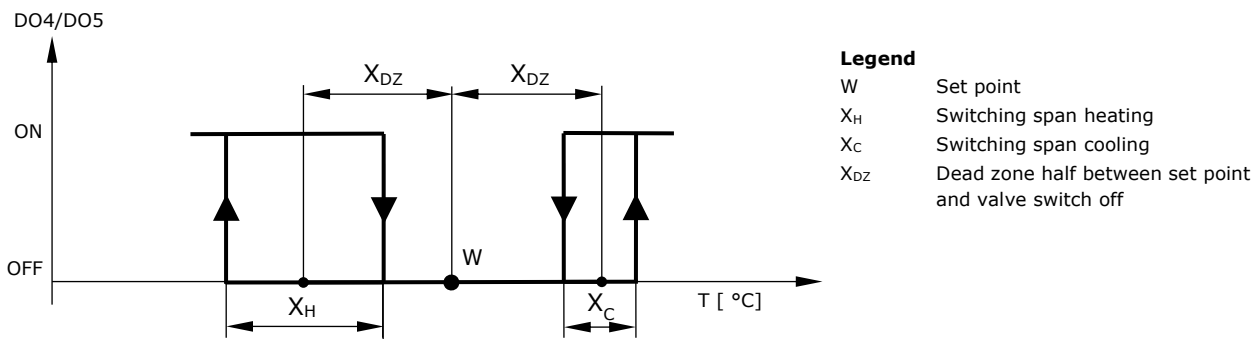


Legend

X_H Switching span heating
 X_C Switching span cooling
 W Set point

5.8.5 on/off control for 4-pipe application heating and cooling mode

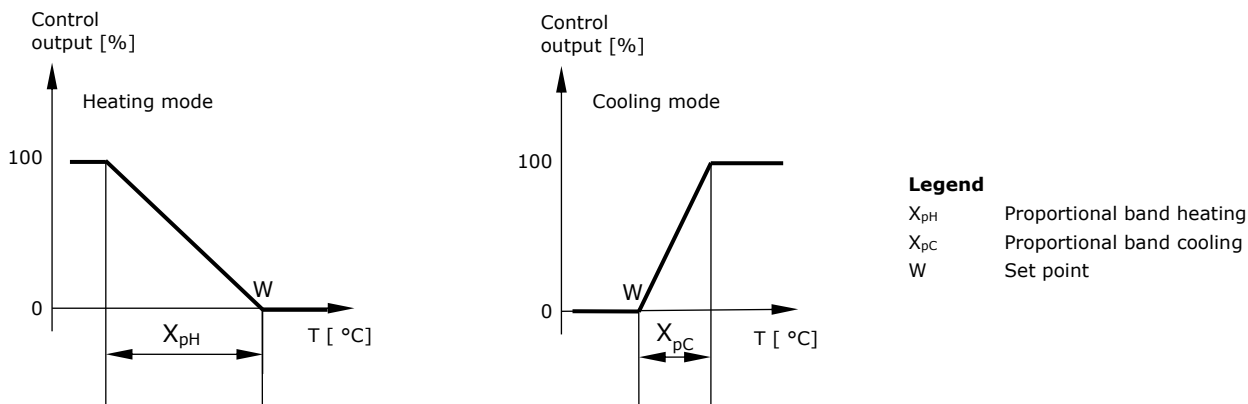
Parameters	Parameter Description	Valid values for given chart
P200	Application mode	6 (= 4-pipe heating and cooling)
P201	Enable electric heater	0
P203	Valve Type	0 (= on/off valve)



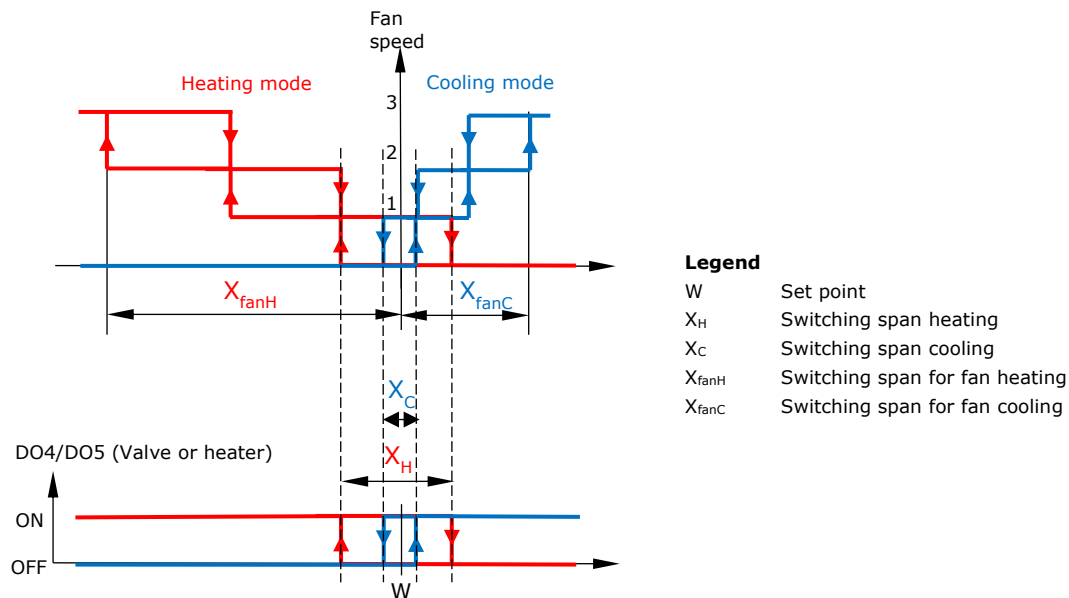
Note that following condition must be met: $\frac{1}{2}X_H + \frac{1}{2}X_C < 2 * X_{DZ}$

5.8.6 3-position control

Parameters	Parameter Description	Valid values for given chart
P200	Application mode	0 - 3, 7 - 8
P201	Enable electric heater	0
P203	Valve Type	1 (= 3-point valve)



5.8.7 Fan control in automatic mode (on/off control)



Note:

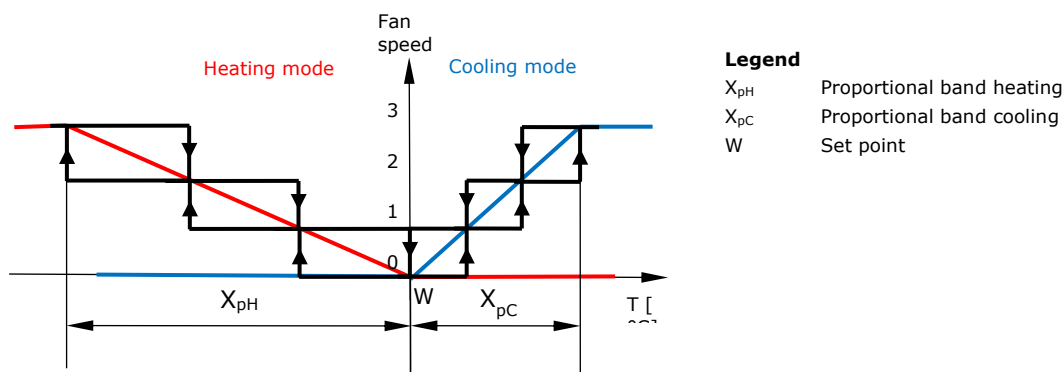
- Fan is off only if the valve (or electric heater) is turned off.
- This chart shows the fan control for 2-pipe and 4-pipe heating or cooling applications (P200 = 0 to 5). For 4-pipe heating and cooling application (P200 = 6), the dead zone between heating and cooling switch point is not depicted.
- This chart assumes P213 (Minimum fan speed in auto mode) is set to 0 = Fan off (default).

Fan speed 1 is aligned with on/off valve (or electric heater). If the valve (or electric heater) switches ON for heating/cooling then the fan speed 1 is switched ON. If the valve (or electric heater) switches OFF then the fan speed is switched OFF (in case P213 minimum fan speed in auto mode is 0)

X_H / X_C [°C]	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
X_{fanH} / X_{fanC} [°C]	2	3	4	5	6	7	8	9	10

For the remaining X_H / X_C : $X_{fanH} = X_H * 2 + 1$ and $X_{fanC} = X_C * 2 + 1$

5.8.8 Fan control in automatic mode (3-position control)



5.9 Temperature and digital inputs

5.9.1 Parameter P5xx overview

With parameter P500 – P503 input type and functionality of RT1 and RT2 can be set.

With parameter P504 – P505 the automatic heat/cool changeover level can be set.

With parameter P506 the built-in temperature sensor calibration (temperature offset) can be set.

If RT1/2 is set to 0 = NTC and an open or short circuit is detected, the error Err3 is generated.

Par/Addr	Description	Data type / value	Default	R/W
P500	Input RT1 Configuration	0 = Not assigned 1 = Control input instead of built-in temperature sensor (NTC) 2 = Heat/cool changeover or floor temperature sensor (NTC or DI) 3 = Occupation sensor – Comfort / Economy (DI) 4 = Occupation sensor – Comfort / Protection (DI) 5 = Door switch (DI, in combination with occupation sensor on RT2) 6 = Electric heater overheat sensor (DI) 7 = Dew point sensor (DI)	0	R/W
P501	Definition of RT1	0 = NTC temperature sensor 1 = Normally Open (DI) 2 = Normally Closed (DI)	0 = NTC	R/W
P502	Input RT2 Configuration	0 = Not assigned 1 = Control input instead of built-in temperature sensor (NTC) 2 = Heat/Cool changeover or floor temperature sensor (NTC or DI) 3 = Occupation sensor – Comfort / Economy (DI) 4 = Occupation sensor – Comfort / Protection (DI) 5 = Not used 6 = Electric heater overheat sensor (DI) 7 = Dew point sensor (DI)	0	R/W
P503	Definition of RT2	0 = NTC temperature sensor 1 = Normally Open (DI) 2 = Normally Closed (DI)	1 = NO	R/W
P504	Automatic heat/cool changeover level for cooling	Multiplier: 10 5.0...20.0 °C	15.0 °C	R/W
P505	2-/4-pipe system: Automatic heat/cool changeover level for heating Floor heating system: Floor temperature limit	Multiplier: 10 20.0...40.0 °C	30.0 °C	R/W
P506	Built-in temperature sensor calibration	Multiplier: 10; Integer (signed) -3.0...+3.0 °C	0.0 °C	R/W
P507	Dew point mode	0 = Fan speed 1, alarm inactive in protection mode 1 = Fan speed 1, alarm active in protection mode 2 = Fan speed 2, cooling active (as dehumidifier), alarm active in protection mode	0	R/W

5.9.2 P500/502: 2 = Heat/cool changeover or floor temperature sensor (NTC or DI)

Heat/cool changeover (NTC or DI)

P200 (Application mode) must be set to 3 or 5. Otherwise an error occurs (Err4).

If P501/P503 = 0 = NTC temperature sensor, the controlling mode changes to cooling mode if the temperature on RT1/2 is lower than specified in P504. The controlling mode changes to heating if the temperature on RT1/2 is higher than specified in P505.

If RT1 and RT2 are not specified as Heat/cool changeover, the controlling mode changes to fan only. If the heat/cool changeover sensor defined as NTC has a short circuit or open contact, the controlling mode changes to fan only.

Floor temperature sensor (NTC)

P200 (Application mode) must be set to 7 (Floor heating system) and the corresponding P501/P503 = 0 = NTC. Otherwise, an error occurs (Err4).

If the floor temperature sensor exceeds the floor temperature limit (P505), the heating valve is turned off until the floor temperature is 2 °C lower than the floor temperature limit.

5.9.3 P500/502: 3/4 = Occupation sensor

Occupation sensors are used to change the operating mode, either between comfort/economy or comfort/protection. This function may be used together with key card switches for hotels or motion detectors for offices. If protection and economy mode are controlled by an occupation sensor, protection mode has priority.

When an occupation sensor is configured, the operating mode can be set manually to economy or protection with Modbus or the power button. If the sensor signals protection mode, the operating mode cannot be changed.

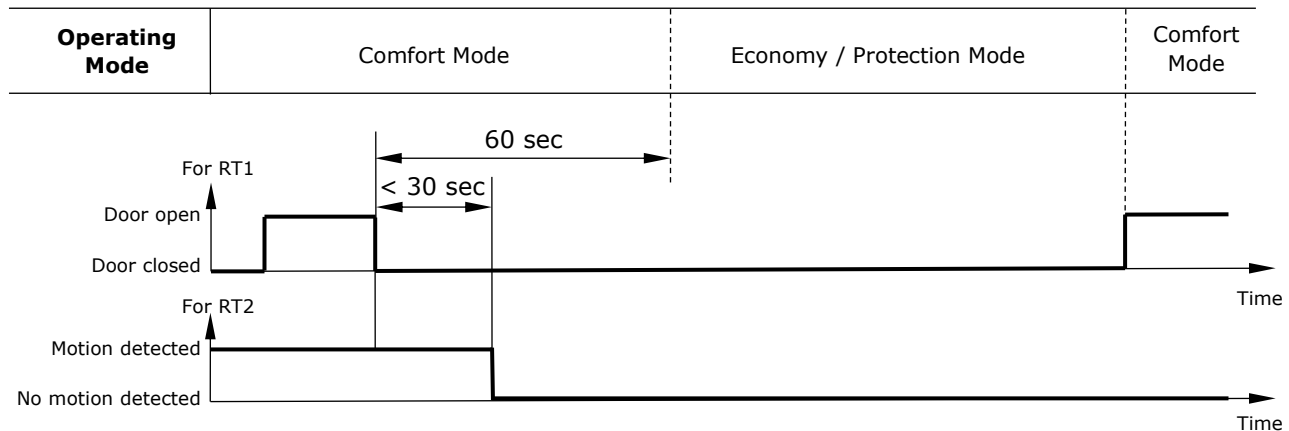
5.9.4 P500: 5 = Door switch (DI) and P502: 3 or 4 = Occupation sensor (DI)

As soon as P500 is set to 5 = Door switch and P502 is set to 3 or 4 = Occupation sensor, the device is configured as “**fool-proof presence detection**”. If P502 is set to another value than 3 or 4 an error (Err4 and P502) is shown.

The use of a key switch may be avoided by using a door contact and a motion detector. The room will go to Economy mode (P502 = 3) or Protection mode (P502 = 4) 60 seconds after the door is opened and closed again and if there is no movement in the room after the door closes (RT2 is evaluated 30 seconds after the door is opened and closed).

If there is movement in the room or the door is opened; the room will go to Comfort mode again and stays in Comfort mode unless the door is opened and closed again.

The motion detectors should be placed in each room in order to detect the presence of an occupant. Keep the delay of the motion detector output below 30 seconds.



5.9.5 P500/501: 6 = Electric heater overhear sensor

This sensor is used to prevent overheating of the electric heater. An overhear sensor with digital output (open contact) is connected to RT1/2. If there is an overhear alarm, the electric heater is shut down immediately. The fan will continue running at fan speed 1 and ALA4 is shown. After the alarm is cleared and the fan extension time has expired, the controller will return to normal operation.

5.9.6 P500/502: 7 = Dew point sensor

Dew point sensor are used for cooling applications (chilled ceiling, etc.) to avoid condensation. A dew point sensor with digital output (open contact) is connected to RT1/2. If there is a condensation alarm the cooling valve is closed and cooling control output is set to 0 (D1301). In cooling mode, the fan speed is set to 1 if there is condensation alarm.

5.9.7 P507 Dew point mode

The functionality of a dew point alarm can be adjusted with P507. Changing P507 results in different behavior in case of a dew point alarm; The activated fan speed, cooling activation and the activity in protection mode can be adjusted.

Configuration of P507	Fan speed	Cooling active	Protection mode
0	1	No	No
1	1	No	Yes
2	2	Yes	Yes

5.9.8 P500/502 digital input assignment

If P501/P503 is in digital input mode the function or mode assignment for open and close contact are listed here:

Configuration of RT1/2 (P500/P502)	Definition of RT1/2 (P501/P503)	Contact open	Contact closed
2 = Heat/cool changeover (NTC or DI)	1 = Normally Open (DI)	Heating	Cooling
	2 = Normally Closed (DI)	Cooling	Heating
3 = Occupation sensor – Comfort / Economy (DI)	1 = Normally Open (DI)	Economy	Comfort
	2 = Normally Closed (DI)	Comfort	Economy
4 = Occupation sensor – Comfort / Protection (DI)	1 = Normally Open (DI)	Protection	Comfort
	2 = Normally Closed (DI)	Comfort	Protection
5 = Door switch (DI, in combination with occupation sensor of other input)	1 = Normally Open (DI)	Door closed	Door open
	2 = Normally Closed (DI)	Door open	Door closed
6 = Electric heater overheat alarm (DI)	1 = Normally Open (DI)	No alarm	Overheat alarm
	2 = Normally Closed (DI)	Overheat alarm	No alarm
7 = Dew point sensor (DI)	1 = Normally Open (DI)	No alarm	Dew point alarm
	2 = Normally Closed (DI)	Dew point alarm	No alarm

5.10 Load and store default settings

5.10.1 With user interface

Press up and down for minimum 3 seconds to enter the password protected default settings.

Enter the default settings with CODE 245. Choose between default TRA-F12x-A "dEF" and OEM "OE" configuration copy menu. Navigate with Up (▲), Down (▼), Enter (♣) and Return Buttons (↻, ↺).

After a load or store action the small digits show "Good" and the default settings menu is closed.

Large Digits	Small Digits	Action with Enter Button (♣)
dEF	no	No action
	LOAd	Load default TRA-F12x-A configuration (as described in this manual)
OE	no	No action
	LOAd	Load default OEM configuration
	SAVE	Save default OEM configuration

5.10.2 With Modbus

Via Modbus the default settings can be accessed by writing 2 registers (with function code 0x10 write multiple registers) to data address 37. After a load or store command via Modbus, the small digits show "Good" and the large digits show "CPy" on the user interface. This function does not work for BACnet controllers.

Addr	Description	Required Qty	Data type	R/W
37	Default configuration type	2 registers (function code 0x10: write multiple registers)	0 = Default TRA-F12x-A configuration 1 = OEM default configuration	W
38	Action for default configuration		0 = No action 1 = Load config. as defined with address 37 2 = Save actual config. to OEM default (only valid when address 37 = 1)	W

6 Modbus Runtime Data

6.1 Modbus function codes

The controller supports the following Modbus function codes:

Modbus function code	Data
Read multiple register (0x03)	Read n registers (n x 2 bytes) starting from requested address.
Write register (0x06)	Write 1 register (2 bytes) at requested address.
Write multiple registers (0x10)	Write n register (n x 2 bytes) starting from sent address.

Note: The read/write capability of each data element is defined in column "R/W". Most data can be read and written defined as "R/W". Read only data are defined as "R".

6.2 Resolution and data format

All temperature related data are given in °C for Modbus. Only in the user interface values can be shown in °F.

Data without multiplier have resolution 1. Data with multiplier 10 have resolution 0.1.

For example, the default value of Comfort temperature set point (P300) is 20.0 °C and the value read via Modbus is 200 (because of multiplier 10 used for P300).

Data with values below 0 (zero) are given as signed integer values.

6.3 Address table of controller runtime data

Data/Addr	Description	Data type / value	Default	R/W
1000	Vector product series information	27 = TRA-F121-A	27	R
1001	Product type information	0 = Standard version	0	R
1002	Controller software version	n = Version n	none	R
1003	Controller software revision	n = Revision n	none	R
1004	Alarm	0 = No alarm 1 = Dew point alarm from RT1/2 (P500/502 = 7) 2 = Overheat protection alarm 3 = Frost protection alarm	0	R
1005	Error	0 = No error 1 = Built-in temperature sensor error 2 = Temperature sensor RT1/RT2 error 3 = Digital input is not open/close 4 = Configuration error 5 = Time error (time not set)	0	R
1100	Operating mode	0 = Comfort 1 = Economy 2 = Protection	0	R/W
1101	Controlling mode	0 = Heating 1 = Cooling 2 = Fan only	0	R/W
1102	Fan speed value	0 = Fan off 1 = Low Fan 2 = Mid Fan 3 = High Fan	1	R/W
1103	Fan mode	0 = Automatic 1 = Manual (set to manual if fan speed value changed from Modbus master)	0	R/W
1200	Room temperature (Built-in sensor)	Multiplier: 10; Integer (signed) -20.0...80.0 °C (-4.0...176 °F) -100.0 (= 0xFC18) = Sensor damaged	none	R
1201	External temperature RT1	Multiplier: 10; Integer (signed) -20.0...80.0 °C (-4.0...176 °F) -100.0 (= 0xFC18) = none (digital input)	none	R
1202	External temperature RT2	Multiplier: 10; Integer (signed) -20.0...80.0 °C (-4.0...176 °F) -100.0 (= 0xFC18) = none (digital input)	none	R

Data/Addr	Description	Data type / value	Default	R/W
1203	Outdoor temperature Modbus	Multiplier: 10; Integer (signed) -20.0...60.0 °C -100.0 (= 0xFC18) = no valid temperature received yet	none	R/W
1204	RT1 digital input	0 = OFF 1 = ON -1 = none (Temperature input)	none	R
1205	RT2 digital input	0 = OFF 1 = ON -1 = none (Temperature input)	none	R
1300	Heating control output	0...100 %	none	R
1301	Cooling control output	0...100 %	none	R
1302	DO1 output state	0 = OFF 1 = ON	none	R
1303	DO2 output state	0 = OFF 1 = ON	none	R
1304	DO3 output state	0 = OFF 1 = ON	none	R
1305	DO4 output state	0 = OFF 1 = ON	none	R
1306	DO5 output state	0 = OFF 1 = ON	none	R

7 BACnet

7.1 MS/TP communication specifications

7.1.1 Features

- BACnet MS/TP communication over RS485
- B-ASC Device Profile
- Supports up to 5 Change Of Value (COV) subscriptions
- Slave type of communication
- Supports up to 128 nodes on one network
- Galvanic isolated bus connection
- Baud rates: 9600 / 19200 / 38400 / 57600 / 76800 / 115200

7.1.2 PICS: Protocol Implementation Conformance Statement

Vendor Name: Vector Controls

Product Name: TRA-F122-A series

TRA product description: The TRA fan coil BACnet controllers are designed for fan coil applications and can be used to control fan coil units on a BACnet MS/TP network.

7.1.3 Supported BACnet® Interoperability Blocks (BIBB)

The BACnet® interface conforms to the B-ASC device profile (BACnet® Application Specific Controller).

The following BACnet® Interoperability Building Blocks (BIBB) are supported.

BIBB	Type	Name
DS-RP-B	Data sharing	Read property - B
DS-RPM-B	Data sharing	Read property multiple - B
DS-WP-B	Data sharing	Write property - B
DS-COV-B	Data sharing	Change of value - B
DM-DCC-B	Device management	Device communication Control - B
DM-DDB-B	Device management	Dynamic device binding - B
DM-DOB-B	Device management	Dynamic object binding - B
DM-RD-B	Device management	Reinitialize device - B

7.1.4 Supported standard BACnet® application services

- ReadProperty
- ReadPropertyMultiple
- WriteProperty
- ChangeOfValue (max. 5 COV subscriptions supported)
- DeviceCommunicationControl. Needs a password which is "VectorControl" (case sensitive and without the quotes).
- I-Am
- ReinitializeDevice ("cold" or "warm"). Needs a password which is "VectorControl" (case sensitive and without the quotes).

7.1.5 Supported standard Object types

- Device
- Analog input
- Analog value
- Binary value
- Multi-state Value
- Network Port

7.2 Properties of supported BACnet objects

7.2.1 Device Object

Property	Description	Format	R/W
APDU Timeout	Time between retransmissions in milliseconds. This device does not support retransmissions, so this always reads as "0".	Integer	R
App Software Version	Controller Firmware Version (assembled by firmware) VXXrY ("X" = version, "Y" = revision)	String	R
Database Revision	Increases if the settings change	Integer	R
Daylight Savings Status	Daylight savings status of host controller	Boolean	R
Description	Description of controller or location	String	R
Device Address Binding	Address binds	List	R
Firmware Revision	BACnet Firmware Revision	String	R
Max APDU Length Accepted	The maximum APDU length supported by this device is 208.	Integer	R
Max Info Frames	The value specifies the maximum number of information frames the node may send before it must pass the token. (Writable in network port)	Integer	R
Max Master	Number of the highest addressed node: 1-127 (Writable in network port)	Integer	R
Model Name	Controller product name "TRA-F122-A" (assembled by firmware)	String	R
Number of APDU Retries	Number of retransmissions. This device does not support retransmissions, so this always reads as "0".	Integer	R
Object Identifier	Device object identifier built from PAR007/008	Integer	R/W
Object Name	Name of device	String	R
Object Type	The value is always "8: Object Device" for the device object	List	R
Protocol Objects Supported	The enumeration of the supported object types	List	R
Protocol Revision	BACnet protocol revision number	Integer	R
Protocol Services Supported	The enumeration of the supported services	List	R
Protocol Version	BACnet protocol version number	Integer	R
Segmentation Supported	This device does not support segmentation, so this always reads as "NO SEGMENTATION (3)".	List	R
System Status	Current physical and logical status supported, this always reads as "OPERATIONAL".	List	R
Vendor Identifier	561	Integer	R
Vendor Name	Vector Controls GmbH	String	R

7.2.2 Analog Input Object (AI)

Property	Description / Property description	Format	R/W
Object Identifier	AI number	Integer	R
Object Name	Name of the input	String	R
Present Value	Current value of input	Floating Point	R
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Reliability	NO FAULT DETECTED, NO SENSOR, OVER RANGE, UNDER RANGE, UNRELIABLE OTHER	List	R
Out Of Service	Writing to Out Of Service property is not supported	Boolean	R
Units	Describes the units used	List	R
COV Increment	Minimum change in present value that will cause a COV notification.	Floating point	R/W

7.2.3 Analog Value Object (AV)

Property	Description / Property description	Format	R/W
Object Identifier	AV number	Integer	R
Object Name	Name of the value	String	R
Present Value	Current value of input	Floating Point	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
Units	Describes the units used. Degree Celsius or Fahrenheit has to be set by MV02.	List	R
COV Increment	Minimum change in present value that will cause a COV notification.	Floating point	R/W

7.2.4 Binary Value Object (BV)

Property	Description / Property description	Format	R/W
Object Identifier	BV number	Integer	R
Object Name	Name of the input	String	R
Present Value	Current value of the object 0 = OFF / Disabled / Inactive 1 = ON / Enabled / Active	Boolean 0/1	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R

7.2.5 Multi State Value Object (MV)

Property	Description / Property description	Format	R/W
Object Identifier	MV number	Integer	R
Object Name	Name of the input	String	R
Present Value	Current value of the object	Integer	R/W
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Event State	Always NORMAL	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
Number Of States	Number of states of this object	Integer	R

Note: All parameters represented as Multi State Value Objects have offset 1. The parameter value reads as MSVxx Present Value – 1.

7.2.6 Network Port Object

Property	Description / Property description	Format	R/W
Object Identifier	Network port number	Integer	R
Object Name	Network port name	String	R
Status Flags	In Alarm, Fault, Overridden, Out Of Service	List	R
Out Of Service	Writing to Out Of Service property is not supported	List	R
APDU length	BACnet maximum APDU length	Integer	R
Changes pending	Changes pending flag indicating parameter changes in Network port object	Boolean 0/1	R
Link speed	Baud rate of MS/TP communication	Integer	R/W
Mac Address	Mac Address used on this network	Octet string	R/W
Max Info Frames	Maximum info frames of MS/TP communication before the token must be passed	Integer	R/W
Max Master	Maximum master instance for MS/TP communication (0 to 127)	Integer	R/W
Network number	Network number of this device. 0 indicates that network number cannot be determined.	Integer	R
Network number quality	Current quality of network number property	List	R
Network type	Network type in use	List	R
Protocol level	Indication of protocol in use	Integer	R
Reliability	Indication whether the port connected to is reliable	List	R

Note: If any of the writable properties above is changed, the changes pending flag is set. To activate the changes, it is necessary for the client to initiate a ReinitializeDevice service request with "ACTIVATE_CHANGES" or "WARMSTART".

7.3 Available objects

7.3.1 System settings

Par No.	Object	Name	Description	R/W
0	MV 00	AppSelect	Application selection 1 = Default TRA application, 2 = 2-pipe heating only, ..., 20 = Heated/chilled ceiling	R/W
5	BV 05	BootIAm	Send I Am at boot	R/W
6	BV 06	AllowChange	Allow parameter change from BACnet	R/W

7.3.2 Operating options

Par No.	Object	Name	Description	R/W
100	MV100	BigDigits	Display on big digits 1 = Room temperature, 2 = Current set point	R/W
101	MV101	SmallDigits	Display on small digits 1 = No display, 2 = Outdoor temperature via BACnet	R/W
102	MV102	Unit	Selection of temperature unit 1 = °C, 2 = °F	R/W
103	BV103	EnEco	Enable economy mode	R/W
104	BV104	EnUnitChange	Enable temperature unit change	R/W
105	BV105	EnSetPoint	Enable change of temperature set point via user interface	R/W
106	BV106	EnManFan	Enable manual fan control via user interface	R/W
107	BV107	EnHCF	Enable manual Heating/cooling/fan control via user interface	R/W
108	MV108	KeyLock	Key lock selection 1 = Disabled, 2 = Key locked, unlockable with buttons, 3 = Keys locked from BACnet	R/W
109	MV109	ParChangeEn	Enable all parameters from user interface 1 = Disabled, 2 = Enabled	R/W
110	MV110	StatePF	State after power failure 1 = Protection Mode (OFF), 2 = Comfort mode (ON), 3 = State before power failure	R/W
111	MV111	EnParamScope	Enable parameter (P103-P107) scope 1 = Only valid for user interface, 2 = Valid for user interface and BACnet	R/W

7.3.3 System and output configuration

Par No.	Object	Name	Description	R/W
200	MV200	AppMode	Application mode selection 1 = Heating only, 2 = Cooling only, ..., 10 = Heated/chilled ceiling system	R/W
201	MV201	ElectricHeater	Enable electric heater 1 = OFF, 2 = ON	R/W
202	AV202	ElHeatTrail	Fan extension time after electric heater	R/W
203	MV203	ValveType	Valve type for heating/cooling system 1 = on/off valve, 2 = 3-point valve, 3 = 2-position valve	R/W
204	AV204	ValveRT	3-point valve running time	R/W
205	AV205	MinOnTVValve	Minimum on time of valve for on/off valve	R/W
206	AV206	MinOffTVValve	Minimum off time of valve for on/off valve	R/W
207	MV207	NrFanSpeeds	Number of fan speeds 1 = 1 fan speed, 3 = 3 fan speeds	R/W
208	AV208	MinOnTFan	Minimum on time of each fan speed	R/W
209	AV209	LFanSw	Low fan switch on level	R/W
210	AV210	MFanSw	Medium fan switch on level	R/W
211	AV211	HFanSw	High fan switch on level	R/W
212	AV212	FanKick	Fan kick period	R/W
213	MV213	MinFanAuto	Minimum fan in auto mode 1 = Fan off, 2 = Low speed	R/W
214	MV214	MinFanMan	Minimum fan in manual mode 1 = Fan off, 2 = Low speed	R/W
215	MV215	MaxFanEco	Maximum fan speed in economy mode 1 = Fan speed 1, 2 = Fan speed 2, 3 = Fan speed 3	R/W

7.3.4 Set points

Par No.	Object	Name	Description	R/W
300	AV300	ComfortSP	Comfort temperature set point	R/W
301	AV301	EcoHeatSP	Economy heat set point	R/W
302	AV302	EcoCoolSP	Economy cool set point	R/W
303	AV303	OverheatSP	Overheat protection temperature value	R/W
304	AV304	FrostSP	Frost protection temperature value	R/W
305	AV305	MinSPHeat	Minimum set point heating mode	R/W
306	AV306	MaxSPHeat	Maximum set point heating mode	R/W
307	AV307	MinSPCool	Minimum set point cooling mode	R/W
308	AV308	MaxSPCool	Maximum set point cooling mode	R/W

7.3.5 Control settings

Par No.	Object	Name	Description	R/W
400	AV400	PBandHeat	Proportional band in heating mode	R/W
401	AV401	PBandCool	Proportional band in cooling mode	R/W
402	AV402	IntegralT	Integral time	R/W
403	AV403	DeadZone	Dead zone half span for heating and cooling application	R/W

7.3.6 Temperature and digital inputs

Par No.	Object	Name	Description	R/W
500	MV500	RT1Conf	Input RT1 configuration 1 = Not assigned, 2 = Control input, ..., 8 = Dew point sensor	R/W
501	MV501	RT1Def	Definition of RT1 input 1 = NTC, 2 = Normally Open DI, 3 = Normally closed DI	R/W
502	MV502	RT2Conf	Input RT2 configuration 1 = Not assigned, 2 = Control input, ..., 8 = Dew point sensor	R/W
503	MV503	RT2Def	Definition of RT2 input 1 = NTC, 2 = Normally Open DI, 3 = Normally closed DI	R/W
504	AV504	HCChangeCool	Automatic heat/cool changeover level for cooling	R/W
505	AV505	HCChangeHeat	Automatic heat/cool changeover level for heating	R/W
506	AV506	TSensCalib	Built-in temperature sensor calibration	R/W
507	MV507	DewPointMode	Dew point mode	R/W

7.3.7 Runtime data

Error and Alarm

Object	Name	Description	R/W
MV1004	Alarm	Alarm indication 1 = No alarm, 2 = dew point alarm, 3 = overheat alarm, 4 = frost alarm	R
MV1005	Error	Error indication 1 = No error, 2 = Built-in sensor error, 3 = RT1/RT2 error, 4 = DI1/DI2 error, 5 = configuration error	R

Operating data

Object	Name	Description	R/W
MV1100	OPMode	Operating mode 1 = Comfort, 2 = Economy, 3 = Protection	R/W
MV1101	CtrlMode	Controlling mode 1 = Heating, 2 = Cooling, 3 = Fan only	R/W
MV1102	FanSpeed	Current fan speed 1 = Fan Off, 2 = Low Fan, 3 = Mid Fan, 4 = High Fan	R/W
MV1103	FanMode	Fan mode auto or manual 1 = Auto, 2 = Manual	R/W

Input values

Object	Name	Description	R/W
AI1200	RoomTemp	Room temperature (built-in sensor)	R
AI1201	RT1Temp	External temperature RT1	R
AI1202	RT2Temp	External temperature RT2	R
AV1203	OutTemp	Outdoor temperature from BACnet -20.0...60.0°C -100.0 = no valid temperature received yet	R/W

Output and control values

Object	Name	Description	R/W
AV1300	LpOutH	Heating control output	R
AV1301	LpOutC	Cooling control output	R
BV1302	DO1ST	DO1 output state	R
BV1303	DO2ST	DO2 output state	R
BV1304	DO3ST	DO3 output state	R
BV1305	DO4ST	DO4 output state	R
BV1306	DO5ST	DO5 output state	R

8 Additional Information

8.1 Conventions

The following presentation conventions apply to this manual:



DANGER

Indicates a hazard with a high degree of risk. Failure to observe this warning may result in immediate danger of serious injury or death.



Information

Further information, important operating instructions, other details.



Reference to another document or other text passages in this document.

8.2 Abbreviations used

Abbr.	Meaning
DI	Digital input
DO (n)	Digital output
GND	Ground
L	Line voltage
N	Neutral voltage
NC	Normally closed
NO	Normally open
NTC	Negative Temperature Coefficient
REF	Reference
RH	Relative humidity
RT (n)	Input (DI or NTC sensor)
STP	Shielded Twisted Pair (Cable)

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Smart Sensors and Controls Made Easy!

Quality - Innovation – Partnership

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