TCX2-14050-MOD
Communicating Cabinet Mounted Fan Coil Controller

TCX2-14050-MOD

AEC-PM1

OPA2-VC

Features

- RS485 bus communication with remote operation terminal OPA2-VC.
- Slave Modbus communication over RS485 RTU or ASCII
- Universal PI and/or binary control for any input/output.
- Multiple auxiliary functions: heat-cool auto changeover, automatic enable, set point compensation, occupancy control.
- Economizer function
- Differential, averaging, min and max functions
- Light switching function.
- 8 free assignable alarm or interlock conditions, Selectable state of outputs on alarm condition.
- Password protected programmable user and control parameters.
- Clone parameter sets with plug-in memory AEC-PM1 – easily transport application parameters to multiple controllers.
- Exchange data with PC using the EasySet tool.

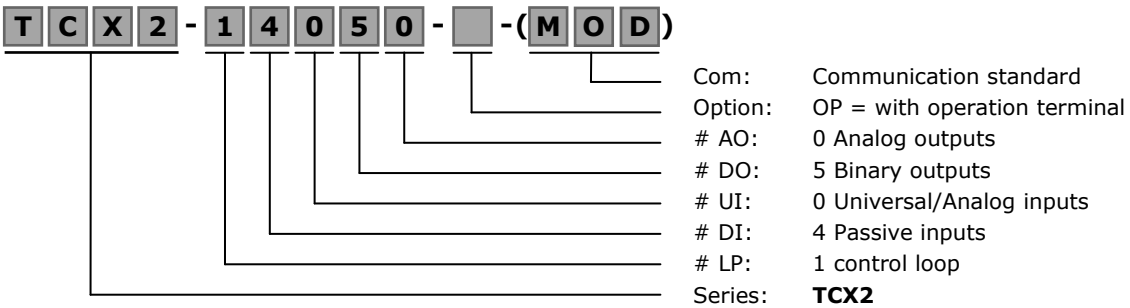
Applications

- Fan coil units
- Fan, Pump control
- Ventilation
- Radiant heating/cooling

General

- The TCX2 is a programmable electronic universal controller with communication capabilities. Each control loop may use 2 PI sequences and 6 binary stages. The TCX2 comes with a built in RS485 communication interface that allows peer to peer communication with an operation terminal e.g. OPA2-(2HT)-VC or a PC.
- The TCX2 communicating MODBUS controllers are designed as universal controls equipment suitable for a large number of applications. They may be used in zoning and other applications which are monitored by a MODBUS RS485 network.
- Flexible application configuration is made with a parameter-setting routine using the standard operation terminal.
- Complete parameter sets may be copied by use of an accessory called AEC-PM1 or exchanged with a PC using an RS485-USB converter and the EasySet program.

Name



Ordering

Model	Item#	Description
TCX2-14050-MOD	40-11 0081	Universal controller with BACnet™ MS/TP
OPA2-VC	40-50 0007	Remote operation terminal with temperature sensor
OPA2-2HT-VC	40-50 0023	Remote operation terminal with temperature & humidity sensor + 2 passive inputs
AEC-PM1	40-50 0016	Plug-In memory module
AEC-USB-01	40-50 0046	RS485-USB converter used for EasySet tool to exchange parameter sets with the PC
AMM-1	40-51 0022	Accessory for cabinet door mounting

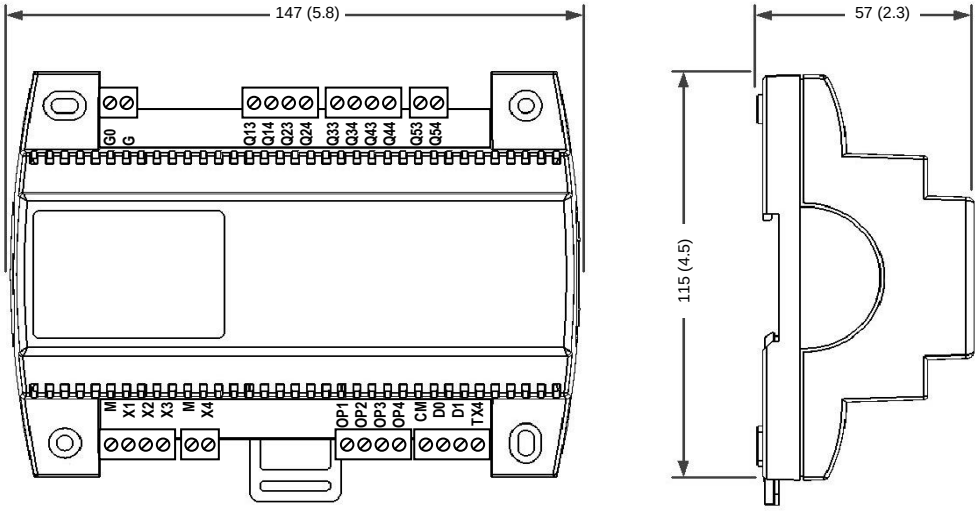
Technical specifications

Important notice and safety advice

This device is for use as operating controls. It is not a safety device! Where a device failure endangers human life and/or property, it is the responsibility of the client, installer and system designer to add additional safety devices to prevent a system failure caused by such a device failure. Ignoring specifications and local regulations may cause equipment damage and endangers life and property. Tampering with the device and misapplication will void warranty.

Power supply	Power requirements	24 VAC ±10%, 50/60 Hz, 24VDC ±10% SELV to HD 384, Class II, 48VA max
	Power consumption	Max. 10 VA
	Electrical connection	Removable terminal connectors, wire 0.34…2.5 mm^2 (AWG 24…12)
Signal inputs	Passive input	Temperature (RT) or open contact
	Type & range:	NTC (Sxx-Tn10): -40…140 °C (-40…284 °F)
Signal outputs	Relays outputs: AC Voltage DC Voltage	0…250 VAC, full-load current 3A, locked-rotor 18A. 0…30 VDC, full-load current 3A, locked-rotor 18A.
	Insulation strength between relays contacts and system electronics: between neighboring contacts:	 4000V AC to EN 60 730-1 1250V AC to EN 60 730-1
Connection to remote terminal	Hardware interface Conductors Galvanic isolation	RS485 in accordance with EIA/TIA 485 Twisted pair cable as specified below The communication circuity is not isolated
Network	Hardware interface Max nodes per network Max nodes per segment Conductors Impedance Nominal capacitance Galvanic isolation Line termination Network topology Recommended maximum length per chain	RS485 in accordance with EIA/TIA 485 128 64 (Vector devices only) Shielded Twisted Pair (STP) cable 100 - 130 ohm 100 pF/m 16 pF/ft. or lower The communication circuitry is isolated A line termination resistance (120 ohm) shall be connected between the terminals (+) and (-) of the furthermost node of the network Daisy chain according EIA/TIA 485 specifications 1200 m (4000 ft.)
Modbus	Communication standard	Modbus (www.modbus.org)
	Default setting	19200 Baud rate, RTU 8 data bits, 1 even parity bit, 1 stop bit
	Communication speed	4800, 9600, 19200, 38400
	Parity bit	no parity, even or odd parity
Environment	Operation Climatic conditions Temperature Humidity	To IEC 721-3-3 class 3K5 0…50 °C (32…122 °F) <95 % RH non-condensing
	Transport & storage Climatic conditions Temperature Humidity Mechanical conditions	To IEC 721-3-2 and IEC 721-3-1 class 3K3 and class 1K3 -25…70 °C (-13…158 °F) <95 % RH non-condensing class 2M2
Standards	CE conformity EMC directive Low voltage directive	 2004/108/EC 2006/95/EC
	Product standards Automatic electrical controls for household and similar use Special requirement on temperature dependent controls	 EN 60 730 –1 EN 60 730 – 2 – 9
	Electromagnetic compatibility for industrial and domestic sector	Emissions: EN 60 730-1 Immunity: EN 60 730-1
	Degree of protection	IP00 to EN 60 529
	Pollution Class	II (EN 60 730-1)
	Safety class: Local regulations must be observed!	III (IEC 60536) if SELV is connected to DO II (IEC 60536) if line voltage is connected to DO.
	Overvoltage category	III (EN 60 730-1)
	c(ETL)us Intertek 4005917 Product standards: Temperature- indicating and -regulating equipment Mark: c(ETL)us	 UL 873 CSA C22.2 No. 24 Certified by Intertek: 4005917
General	Material	Fire proof ABS plastic (UL94 class V-0)
	Dimensions (H x W x D)	57 x 147 x 115 mm (2.3 x 5.8 x 4.5 in)
	Weight (including package)	380g (13.4 oz)

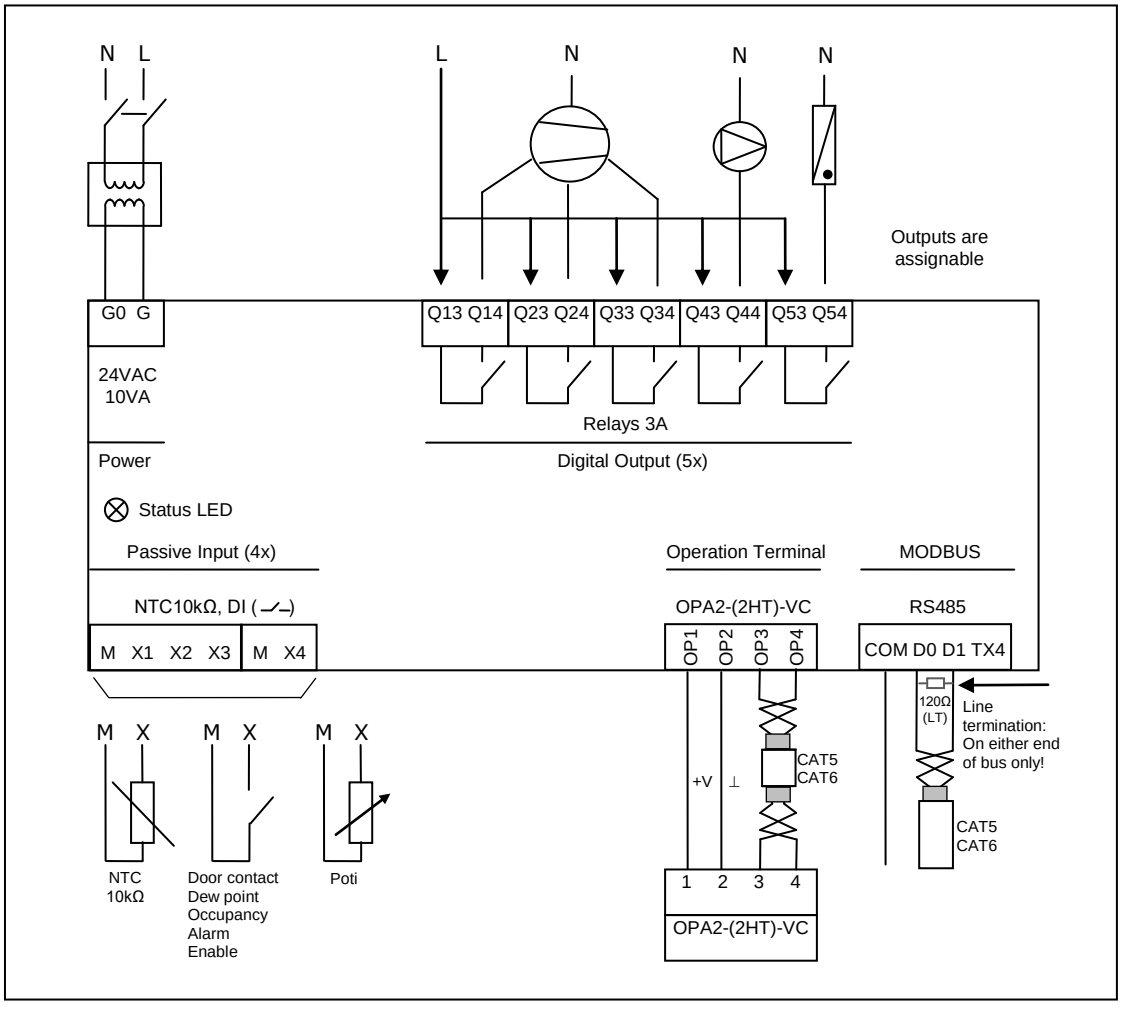
Dimensions, mm (inch)



Installation

- Mount in standard cabinet to DIN 43880
- Surface mounted to top-hat rail to EN 60715 or with 2 #4 screws.
- A protective housing must be used if mounted outside an electrical cabinet.
- Ensure adequate air circulation to dissipate heat generated during operation.
- Observe local regulations.
- Do not mount in a wet or condensation prone environment.

Connection diagram



Selection of actuators and sensors

Temperature sensors: For connections on X1 to X3 use Vector Controls NTC sensors to achieve maximum accuracy: SDB-Tn10-20 (duct), SRA-Tn10 (room), SDB-Tn10-20 + AMI-S10 as immersion sensor.

Modulating actuators: 3-point actuators with constant running time are recommended.

Binary auxiliary devices (e.g. pumps, fans, on/off valves, humidifiers, etc.): Do not directly connect devices that exceed specified limits in technical specifications – observe startup current on inductive loads.

Electrical connections

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.

Use safety insulating transformers with double insulation. They must be designed for 100% ON-time. When using several transformers in one system the connection terminal 1 must be galvanically connected. The TCX2 is designed for operation by AC 24 V, max. 10 Amp, safety extra-low voltage that is short-circuit-proof. Supplying voltages above AC 24 V may damage or destroy the controller or any other connected devices.

Additionally, connections to voltages exceeding 42 V endanger personnel safety. Observe limits mentioned in the technical specifications. Local regulations must be observed at all times.

Bus connection

Wire type
An EIA-485 network shall use shielded, twisted-pair cable for data signaling with characteristic impedance between 100 and 130 ohms. 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.
Line termination
On last node on either end of bus only connect 120Ω termination resistor between (+) and (-).
Maximum length
The maximum recommended length per segment is 1200 meters (4000 feet) with AWG 18 (0.82 mm2 conductor area) cable.
Shield connection
See Ashrae Standard 135 for detailed recommendation regarding how to connect the shield depending on type of nodes present in network.
Vector Controls bus modules are isolated devices.

LED indicators

A status LED is located on the upper left side of the controller housing. During normal operation the LED blinks briefly once every 5 seconds. If there is an alarm or fault condition it will blink every second.

The Modbus slave features a green LED and a red LED for indication of traffic on the RS-485 bus. The green LED is lit when an incoming packet is received, and the red LED is lit when an outgoing packet is transmitted to the bus. At power-up, both LED blink twice simultaneously as a sign of the boot process being completed. A constantly lit LED serves as an indication of a fault condition in the reception or sending process.

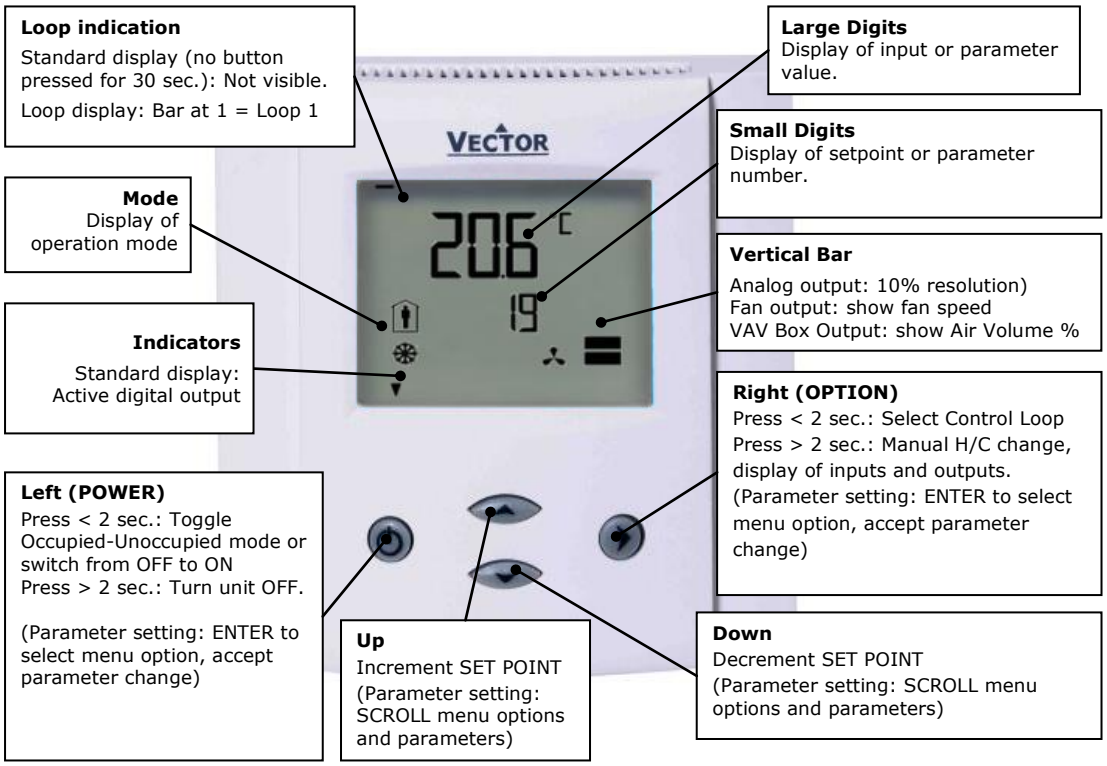
Supported Modbus commands

- 03 (0x03): Read multiple registers
- 06 (0x06): Write single register
- 16 (0x10): Write multiple registers

In commands 03 and 16 the allowed number of registers ranges from 1 to 32. Although Modbus specification would allow more registers to be read and written, a maximum of 32 Modbus registers are supported in one packet. One Modbus register is 16 bits wide. The Modbus slave transmits the values as signed 16 bit integers. The least significant digit of the transmitted number is always the first digit below the decimal point, and this results in the following range of numbers that the slave module is able to transmit: from -9999.9 to 9999.9

In an event of an out-of-range command addressing or an unsupported command, the Modbus slave responds with an exception message according to the Modbus specification.

Display and Operation with OPA2-VC



Operation mode symbols		Control symbols	
	Occupied: (Comfort) All control functions operating per set points.		Heating (reverse) active
	Unoccupied: (Standby, Economy) If enabled, alternative setpoints are used with the intention to reduce energy consumption.		Cooling (direct) active
OFF	OFF: (Energy Hold Off, EHO) Normal control functions are inactive, inputs are monitored for alarms.		Manual override, delay on enable function
		*	Fan active

Idle display

- The idle display is activated when no key has been pressed for 30 seconds.
- The contents of the idle display are selectable through parameters UP08 to UP14.
- Setting UP08 to OFF will disable idle display. Last active control loop or manual output will remain displayed

Loop display

- Active when changing set points. Large digits show input value. Small digits show set point. Horizontal bars top left show which loop is being displayed.

Delay on enable function

- During a pending delay the hand symbol will be shown. For example the condition to activate the controller is met, but a startup delay is specified. The controller will remain switched off and show the hand symbol until the delay expired.

Power Failure

- All parameters and set points are memorized and do not need to be re-entered.
- Upon return of power: Set *Parameter UP05* to keep the unit off, switch on, or operation mode before power failure.

Error messages

Err1: Communication error
Err2: Internal data corrupt. Replace product.
Err3: Internal error. Re-start product. If error reappears, replace product.
Err4: Configuration error. Parameter settings are conflicting. Verify control setup; make sure all assigned inputs are enabled and functioning.
Err5: Parameter copy mode: Copy error – if external module is addressed, communication error with external product
Err6: Parameter copy mode: Check sum mismatch of memory data. Data in external memory is corrupt.

Clock operation

The controller estimates the time by using its internal clock. This time source is accurate to approximate 2 min per day. Should the controller make use of its time schedule functions, it is thus required to synchronize the time at least all 24hours using an accurate time base.
Up to 12 schedules based on time and day of the week may be programmed (Pr01 through Pr12). Schedules may change controller operation mode (on, off, occupied, unoccupied), change fan state, directly position an output, or change a loop set point. A blinking clock indicates that the time has not been set or the unit was without power for longer than 48 hours. The time needs to be set to allow time schedules to operate. Summer / winter time changeover may be activated using user parameters.

Clock setup

Press OPTION > 2 sec. SEL and current time displayed Press OPTION < 2 sec. to change time, Minutes blink: UP/DOWN to change, OPTION to save, Hours blink: UP/DOWN to change, OPTION to save, DAY1 blinks: UP/DOWN to change, OPTION to save weekday Day of month blinks, UP/DOWN to change, OPTION to save Month blinks, UP/DOWN to change, OPTION to save Year blinks, UP/DOWN to change, OPTION to save Press POWER to return	SEL 00:00 DAY1 (Mon) 01.01. 2014

Enable/disable time schedules

Press OPTION > 2 sec. current time and SEL displayed Press UP: PRO and SEL displayed Press OPTION: Time schedule status displayed OFF or ON (🕘) Press OPTION to toggle OFF/ON	SEL PRO 🕘	Pro OFF/ON

Creating time schedules

Step 1: Select a switching time (Up to 12, Pr01–Pr12)

Press UP while PRO-ON displayed: Press UP or DOWN to SCROLL Pr01 through Pr12, Press OPTION to select desired schedule (e.g. Pr01), 00:00 blinks Press UP/DOWN to select Pr01 switching time from 00:00–23:45 Press OPTION to save switching time (bar appears indicating step 1 complete): DAY 1 blinks	**08:00** Pr01

Step 2: Apply selected switching time (Pr01) to DAY1 (Mon) – DAY 7 (Sun)

While Pr01 is displayed and DAY1 is blinking: Press UP: Activate Pr01 switching time for DAY1 (triangle appears on 1), Press DOWN: Deactivate Pr01 switching time for DAY1 (triangle disappears) Press OPTION to save Pr01 DAY1 (2nd bar indicates step 2 complete): Repeat for DAY2 – DAY7	**DAY1** Pr01 ▼ 1 2 3 4 5 6 7

Step 3: Select action for switching time (Pr01+Days)

The selection of switching time and weekdays for this time schedule is now completed. Press POWER to come to desired action for Pro1. The following options appear in this order: no = switching time not active OP = operation mode (ON, OFF, OCCUPIED, UNOCCUPIED) LP = set point AO = Position of analog output (output must be in manual mode by parameter setting) FAN = Fan state (output must be in manual mode by parameter setting) do = Position binary output – digital, 3-point or PWM (output must be in manual mode by parameter setting). Press UP/DOWN to scroll through the possible events(3nd bar indicates step 3 complete) Press Option to complete selection of event	**LP** Pr01

Step 4: Select ID (For example: LP01 or FAN2)

For all non-operation mode changes, it is required to select the output or control loop in this step. For example for setpoint LP1, LP2, etc. or for an output the number of the output that should be changed. Press UP/DOWN to select, OPTION to complete	**LP01** Pr01

Step 5: Complete switching event

Choose operation mode, setpoint or position of output Characteristics of action (e.g. 0–100% for A1) appear (5th bar indicates step 5 complete) Press UP/DOWN to select, OPTION to complete	**25%** Pr01

Manual heat–cool changeover

Press OPTION > 2 sec. SEL and current time displayed Press UP/DOWN Until small digits display H-C: Press OPTION Currently active H or C symbol displayed: Press OPTION again to toggle H or C	**H-C** SEL

Display of in- and output states

Step 1: Select type or in- or output

Press OPTION > 2 sec. SEL and current time displayed Press UP/DOWN Until small digits display SEL, Large digits show: UI = universal inputs AO = Analog outputs FAN = Fan outputs do = Binary, 3-point or PWM outputs Press OPTION to display state of In- or Output	**UI** SEL

Step 2: Select number of in- or output

Press UP/DOWN to step through the number of available in- or outputs Large digits show in-output type & number, Small digits show value	**UI 01** 25%

Step 3: Display total run time for binary outputs

While in binary output mode, Press OPTION key to display the total number of hours the binary output has been ON. Large digits show in-output type & number, Small digits show running time in hours. If the running time is larger than 9999 hours, 10000 hours are shown as level on the vertical bar. The example on the right equals 50345h running time. (Maximum runtime is 65535h = 7.5 years)	**do 01** 345h

Setting of user parameters

1. Press UP/DOWN buttons simultaneously for three seconds. The display will show firmware version and revision number. Press the OPTION button to start login.
2. CODE is shown in small display. Select 009 using UP/DOWN buttons. The access numbers are fixed and cannot be changed.
3. Press OPTION after selecting the correct code. The user/display parameters are displayed immediately.
4. Select the parameters with the UP/DOWN buttons. Change a parameter by pressing the OPTION button. Three arrows are displayed to indicate that the parameter may be modified. Use UP/DOWN buttons to adjust the value.
5. After you are done, press OPTION to save the new value and return to the selection level (arrows disappear when selection is saved). Pressing left hand POWER button without pressing OPTION will discard the value and return without saving.
6. Press the POWER key to leave the menu. The unit will return to normal operation if no button is pressed for more than 5 minutes.

User and display parameters (Password 009)

Parameter	Description	Range	Default
UP 00	Enable access to operation modes	ON/OFF	ON
UP 01	Enable access to set points	ON/OFF	ON
UP 02	Enable manual control in cascade and for fan speeds	ON/OFF	ON
UP 03	Enable change of heating/cooling mode for 2 pipe systems	ON/OFF	ON
UP 04	Enable access to time programs:	ON/OFF	ON
UP 05	State after power failure: 0= off, 1= on, 2= state before power failure	0, 1, 2	2
UP 06	Enable Economy (unoccupied) Mode. Shift the setpoint to a lower temperature in winter or higher temperature in summer in order to save energy. Economy mode may be activated through the POWER button, or with the external input (typically for key card switches in hotel rooms or motion detectors for meeting rooms.)	ON/OFF	OFF
UP 07	Celsius or Fahrenheit: ON= Fahrenheit, OFF= Celsius	ON/OFF	OFF (Celsius)
UP 08	Show idle display while no key is pressed	ON/OFF	ON
UP 09	Select type of content for large digits (00= OFF): 00 = OFF 01 = Input 02 = Control loop setpoint 03 = Analog output 04 = Fan 05 = Binary output 06 = Clock	0–6	1
UP 10	Select content source for large digits (0= OFF): Input: 1 = UI1, 2 = UI2, 3 = UI3, 4 = UI4, 5 = VI1, 6 = VI2, 7 = VI3, 8 = VI4 Set point: 1 = LP1 Fan: 1 = Fan 1 Binary output: 1 = DO1, 2 = DO2, 3 = DO3, 4 = DO4	0–8	1
UP 11	Select type of content for small digits (same options as UP09)	0–6	2
UP 12	Select content source for small digits (same options as UP10)	0–10	1
UP 13	Select type of content for vertical bar display (same options as UP09)	0–6	3
UP 14	Select content source for vertical bar (same options as UP10)	0-10	1
UP 15	OFF = Do not show heating & cooling state, ON = Display heating & cooling state	ON/OFF	ON
UP 16	OFF = Alarms display only while active, ON = Alarms display until confirmed,	ON/OFF	ON
UP 17	Clock display type (12/24): OFF= 24-hr ON= 12-hr (AM/PM)	ON/OFF	OFF(24hr)
UP 18	Reset timer for manual override in time schedule mode. 0 = Reset of override mode is not active. Time schedules overridden manually will be switched back to scheduled mode at next switching event. 1…255 = Delay for the controller to go back to the scheduled OFF or unoccupied operation mode if the operation mode is changed manually to occupied.	0–255 Min	60(Min)
UP 19	Constant backlight for display: OFF = The backlight is only on when a key has been pressed ON = The backlight is constantly on	ON/OFF	OFF
UP 20	**New Feature:** Do not show input value in loop display OFF = Input value is shown ON = Only setpoint is shown. Input value is not visible in loop display	ON/OFF	OFF
UP 21	**New Feature:** Enable daylight savings mode. If enabled, internal real time clock will be advanced by one hour in summer and delayed one hour in winter	ON/OFF	OFF
UP 22	**New Feature:** TCX2 is in no-reply-mode for OPA2-VC communication OFF = TCX2 is in normal mode for communication with OPA2-VC ON = TCX2 is in no-reply-mode for communication with OPA2-VC No-reply-mode: This mode allows connecting one operation terminal to multiple controllers. One controller must be in normal operation mode and all the others must be set to no-reply-mode. The controllers set to no-reply-mode will follow each command issued by the operation terminal. They will not send responses and their alarm conditions are not monitored by the operation terminal. Setting a controller with only one operation terminal to no-reply-mode will result in communication error on the operation terminal. In this case parameter UP22 can still be changed to 0 through the operation terminal.	ON/OFF	OFF
UP 23	**New Feature:** Wink function: the LED on top lights up constantly if ON OFF = LED has normal function ON = LED is constantly active	ON/OFF	OFF
UP 24	**New Feature:** Summer / winter mode. Used for control loops, to select the corresponding setpoint limits. Set in xL28 OFF = Summer mode (cooling), ON = Winter mode (heating)	ON/OFF	OFF

Setting parameters to configure the controller

TCX2 is an intelligent controller with the flexibility to fit a wide range of applications. The control operation is defined by parameters set using the standard operation terminal. There are two levels:

1. **User/display parameters (password 0009)**
2. **Control parameters (password 0241)**

Recommended set-up procedure:

1. **Connect power supply and inputs**
2. **Make sure Celsius – Fahrenheit settings are correct (UP07)**
3. **Program input parameters**
4. **Program control parameters**
5. **Program output parameters**
6. **Program auxiliary functions and user settings**
7. **Test function of unit**
8. **Switch off power**
9. **Connect outputs**
10. **Reconnect power**
11. **Test control loop**

Parameters are grouped according to modules:

Module	Description	PW
UP	User and display parameters	009
LP	Control loops Lp1	241
UI	Input configuration: 1U to 8U (4 RT + 4 VI)	
AL	Alarm configuration: 1AL to 8AL	
FU	Special functions Fu1 to Fu5	
FAN	Fan output configuration FAN1	
DO	Binary output configuration, do1 to do5	
Co	Communication setup	
COPY	copy mode to copy full parameter sets between run, default and external memory with up to 4 saving locations (AEC-PM1)	

How to change parameters

1. Press UP/DOWN buttons simultaneously for three seconds. The display will show firmware version and revision number. Press the OPTION button to start login.
2. CODE is shown in small display. Select 241 using the DOWN button. The access numbers are fixed and cannot be changed.
3. Press OPTION after selecting the correct code. The user/display parameters are displayed immediately.
4. Once logged in with 241 control modules are displayed (UI, AL, LP, AO, FAN, DO, CO etc.) – select with UP/DOWN and open with OPTION. Then select the ID with UP/DOWN keys: 1U, 2U, 3U etc., open with OPTION. As soon as the module is open its parameters are displayed.
5. Select the parameters with the UP/DOWN buttons. Change a parameter by pressing the OPTION button. Three arrows are displayed to indicate that the parameter may be modified. Use UP/DOWN buttons to adjust the value.
6. After you are done, press OPTION to save the new value and return to the selection level (arrows disappear when selection is saved). Pressing left hand POWER button without pressing OPTION will discard the value and return without saving.
7. Press POWER to leave parameter selection and return to control module selection.
8. Press the POWER to leave the menu. The unit will return to normal operation, if no button is pressed for more than 5 minutes.

How to select active alarms on outputs and special functions

1. Select the parameter as described above
2. Press OPTION to start selecting alarms. AL 1 is now shown in the large digits.
3. Press UP to select the alarm 1, press DOWN to deselect the alarm 1. A selected alarm is visible by a dark triangle on the bottom line of the LCD. The output or function will activate if the corresponding alarm is triggered.
4. Press OPTION to step to alarm 2. Repeatedly press OPTION key to step through all available alarms and select or deselect them by pressing UP or DOWN.
5. Press POWER to leave the alarm selection routine and return to the parameter selection level.

Copying and restoring the entire parameter set

It is possible to backup and refresh the entire parameter set to a second onboard memory (default memory) or a plug-in memory. This simplifies substantially the programming of multiple controllers with identical parameter sets.

Removable plug-in memory AEC-PM1

The plug-in memory is an accessory that can be plugged in on the right side of the TCX2. Once connected, the power LED on the AEC-PM1 lights up. The memory can hold up to 4 individual parameter sets. It is easy for a site engineer to update a variety of standard installations or for an OEM to program his standard setup based on application.

Auto-load

While copying a parameter set to eeprom, the user may choose the auto-load feature. With this feature set, the parameters load automatically when powering up the controller. It is thus possible for a non-technical person to perform a parameter update by simply powering up the controller with the AEC-PM1 plugged in.

Procedure to copy parameter sets

1. Login to engineering parameters as described above.
2. Press UP or DOWN until COPY is selected
3. Press the OPTION key. Select copy source: These are the options:
    0. CLR ⇨ The copy destination will be erased
    1. RUN ⇨ Run-time memory
    2. DFLT ⇨ Default: On board backup memory
    3. EEP1 ⇨ External memory folder 1 on AEC-PM1
    4. EEP2 ⇨ External memory folder 2 on AEC-PM1
    5. EEP3 ⇨ External memory folder 3 on AEC-PM1
    6. EEP4 ⇨ External memory folder 4 on AEC-PM1
4. Press OPTION key. Now select copy destination: These are the options:
    1. RUN ⇨ Run-time memory
    2. DFLT ⇨ Default: On board backup memory
    3. EEP1 ⇨ External memory folder 1 on AEC-PM1
    4. EEP2 ⇨ External memory folder 2 on AEC-PM1
    5. EEP3 ⇨ External memory folder 3 on AEC-PM1
    6. EEP4 ⇨ External memory folder 4 on AEC-PM1
5. Press OPTION key. Your selection is shown on the large digits: source ID to target ID. For example run time memory to eep1 is shown as 1to3. After confirming the selection, choose YES or AUTO to start the copy process. Select NO to abort. AUTO s only available if the target is the external plug in. By selecting AUTO: The parameters will load automatically when the controller is powered up while the AEC-PM1 is plugged in. If one plug-in has several parameter folders with the AUTO flag set the one with the smallest index will be loaded.

    New Feature for products with a communication plug-in. Selecting CO15 = 01 will write back an increased address to the AEC-PM1 after a successful copy. This way it is easier to configure large projects.

6. Press the OPTION key to conclude the selection. The Data LED on the AEC-PM1 plug-in blinks to indicate data communication in case it is copied to or from. PEND is shown while the copy process takes place.
    There are several possibilities for the result:
    - Good: The copy process was successful
    - Fail: Err5, Communication problem. The plug in module is either damaged or missing
    - Fail: Err6, Checksum mismatch. The checksum of the source data was incorrect. Data corruption. This may happen if the plug-in has not been written to before or data corruption took place.

Exchanging parameter sets with a computer

Through a USB/RS485 converter it is possible to read and write parameter sets to a computer by the use a free program called EasySet. The EasySet tool may be downloaded from the vectorcontrols.com website.
To exchange parameter sets, install the EasySet™ configurator program and plug in the USB/RS485 converter to your computer. Connect the RS485 converter to the OP3 (+) and OP4 (-) terminal of the TCX2 using a twisted pair wire. If an OPA2-VC is connected, you must first unplug it. In order to use EasySet, select the port of your USB converter first. Parameter sets may now be read out from the TCX2 to the PC and written back to the TCX2. This makes it possible to keep a parameter library on computer, exchange parameter sets through emails or keep a log file of all the projects completed.

Input & alarm/interlock configuration

Universal inputs (analog, binary or passive)

01 u0	For universal inputs: 1U to 4U: Signal type (0= not active): 1= 0-10V or 0-20mA, 2= 2-10V or 4-20mA, 3= NTC, **New Feature:** 4 = open contact direct (contact open = 100%, closed = 0%) 5 = open contact reversed (contact open = 0%, closed = 100%) 6 = potentiometer input, assign to setpoint selection of control loop 7 = light control mode: toggle and dimmer switch	0–7	1
01 u1	Display minimum value For potentiometer input: lower range limit of potentiometer in 100 Ohm steps New feature: if minimum value is higher than maximum value, the input signal is reversed. 0% input = 100% signal, 100% input = 0% signal	-50–205	0
01 u2	Display maximum value For potentiometer input: Upper range limit of potentiometer in 100 Ohm steps New feature: if minimum value is higher than maximum value, the input signal is reversed. 0% input = 100% signal, 100% input = 0% signal	-50–205	100
01 u3	Range of universal inputs (For analog inputs only: 1u0 = 1,2) 0 = x1 3 = square root 1 = x10 4 = square root x 10 2 = x100 5 = square root x 100	0 – 5	0
01 u4	Analog input unit: 0= no unit, 1= %, 2= °C /°F, 3= Pa	0–3	1
01 u5	When 01u0 = 1-5: Select number of samples taken for low pass filter: Filtering prevents unwanted fluctuation of sensor signals. The controller measures signal inputs every second and calculates the input signal based on a number of measured values and a digital low pass filter. Take into account that signal reaction delays as the number of samples taken for the filter increases. Note: changing this value will as well change 01u8	0–100	3
01 u6	Sensor calibration	Per input range	0.0
01 u7	Calculate mathematical function over multiple inputs (0=not active): 1= average, 2= minimum, 3= maximum, 4= differential UI(n) – UI(n-1)	0–4	0
01 u8	**New Feature:** When 01u0 = 7 (light switch), select auto switch off time. Set to 0, if output should not automatically switch off. Note: Shared value: changing this value will as well change 01u5	00:00s...15:10h MM:SS...HH:MM	00:15 MM:SS

➔ Passive temperature input is NTC 10k@25°C (77°F). Specified accuracy can only be guaranteed using Vector Controls Sxx-Tn10 sensors. Range values described above also apply to temperature inputs.

➔ **Display resolution (01u1 and 01u2)**
Limiting the display range increases set point resolution. A range <25 provides set point steps of 0.1 °C (0.2 °F). A range <125 provides set point steps of 0.5 °C (0.1 °F). Larger ranges increase by 1 step. Square root input range (0xu3) has no influence.
Note: Fahrenheit and differential steps are doubled.

➔ **New Feature: open contact as input type (01u0 = 4 or 5):** For an open contact input on passive inputs set parameter 0xu0 to open contact (4 or 5). If set to 4 (open contact direct), an open contact reads as a high value (100%), a closed contact as a low value (0%). If set to 5 (open contact reversed), an open contact reads as low value (0%) and a closed contact as high value (100%). Note: sensor calibration does not work for binary inputs.

➔ **New Feature: potentiometer input (01u0 = 6)**. A potentiometer may be connected to a passive input. With the display minimum and maximum value the range of the potentiometer can be defined in 100 ohms steps. For example setting the 1u01 to 50 and 1u02 to 120 represents a potentiometer from 5k to 12k Ohm. The resistance is measured and calculated into a 0-100% value.
In order to use the potentiometer as input to a control loop, set the loop set point parameter xL06 to the chosen input where the potentiometer is connected. Based on the potentiometer input, the setpoint will now be moved between the setpoint limits of the control loop.

➔ **New Feature: light control mode: toggle and dimmer switch (01u0 = 7)**: With this feature building light maybe controlled by using push button switches connected to a passive input, a binary output to control the light and an analog output if dimming function is wanted. The binary and analog output need to be assigned to the push button input. Pressing the push button for less than 2 seconds, will toggle the binary output. If dimming function is activated, pressing the push button for longer than 2 seconds will change the input value by 10% per second from 0% to 100% and again back to 0%. Dimming function is activated by assigning an analog output to an input in light control mode.

Virtual input configuration

01 u0	For virtual inputs: 5U to 8U: Select signal source 1 = Operation terminal OPA2-VC, OPU2-2HT-VC, etc. 2 = Bus module: AEX-MOD (Modbus), AEX-BAC (BACnet)	0–2	0
01 u1	Display minimum value	-50–205	0
01 u2	Display maximum value	-50–205	100
01 u3	Range of universal inputs (For analog inputs only) 0 = x1 3 = square root 1 = x10 4 = square root x 10 2 = x100 5 = square root x 100	0 – 5	0
01 u4	Analog input unit of measure: 0= no unit, 1= %, 2= °C /°F, 3 = Pa	0–3	2
01 u5	Not used for virtual inputs. Do not change	0–100	12
01 u6	Sensor calibration	Per input range	0.0
01 u7	Calculate mathematical function over multiple inputs (0=not active): 1= average, 2= minimum, 3= maximum, 4= differential UI(n) – UI(n-1)	0–4	0
01 u8	**New Feature:** Select time out: If the value is not updated within the specified time period, the input will be disabled. If the input is assigned to an active control loop or a function configuration error Err4 is shown.	00:00s...15:10h MM:SS...HH:MM	01:00 MM:SS

➔ Virtual inputs may originate from a remote operation terminal such as the OPA2-VC or from a bus master if a communication module such as the AEX-MOD for MODBUS or AEX-BAC for BACnet is present.

➔ The remote input has a selectable timeout. If the value is not updated within this time out, the input will be disabled and the configuration error Err4 is shown. Rewriting the input value will re-enable the input but will not clear Err4. Err4 can only be cleared by acknowledgement through the right key. Setting the time out to 0 disables its function. For control functions, the time out should not be disabled.
While no additional setup is required on the OPA2, the bus master needs to write its value to the correct address for the input within the time out period. Details are described in the documentation of the communication module.

➔ Inputs of OPA2-VC:
The OPA2-VC has one temperature input. This input is assigned to the first virtual input. For the TCX2-40863 this would be UI7 = VI1. To use the temperature input of OPA2-VC, set 07u0 = 1.

➔ Inputs of OPA2-2HT-VC or OPU2-2HT-VC:
The OPA2-2HT-VC has a temperature input, a humidity input and 2 binary inputs. These inputs are assigned to following virtual inputs:
1. VI1 = UI05 = temperature input
2. VI2 = UI06 = humidity input
3. VI3 = UI07 = passive input 1
4. VI4 = UI08 = passive input 2

Mathematical functions on inputs

➔ Square root calculation on input values: The input signal maybe subjected to the square root function prior to calculating the display values. The square root is calculated from the input signal and the result is again conditioned to 10bit resolution. The square root function is useful when airflow needs to be calculated from differential pressure, as in VAV systems for example.

➔ Calculate mathematical functions over multiple inputs for loop control or display with xxU7. In order to calculate average, minimum or maximum between several inputs, make sure all the inputs are of identical type and range and then activate the same function on xxU7 on all the selected inputs. The largest input of the group selected will carry the calculated value. For example: When average is activated on 02U7 and 01U7 = 1, the average is carried on universal input 2.

UI2 may now be used as input for control loops and it will show the average value of UI1 and UI2 combined.
It is possible to use different functions on different inputs. For example: minimum of UI1 and UI3 and maximum of UI2 and UI4.

➔ The differential function may only be calculated on subsequent inputs. Such as UI2-UI1. The function must only be activated on the minuend (a number from which another number is subtracted) – UI2 in this example. The displayed value of the minuend will change into the difference: UI2 in – UI1 = UI2 out. It is possible to have multiple differentials on one controller. It is not possible to reverse the subtraction: UI1-UI2.

Alarm and interlock configuration

1AL 0	Select alarm type: 0 = Alarm is not active 1 = Input high or low limit (Select input in AL 2) 2 = Max. setpoint deviation of control loop (select loop in AL 1) 3 = Maintenance alarm from run time counters (select counter in AL 1) 4 = Feedback alarm for fan, supervise fan state (Select fan in AL 1) **New Feature:** 5 = Feedback alarm for binary output (select output in AL 1) 6 = Feedback alarm for analog output (select output in AL 1) 7 = Level alarm or interlock for PI-sequence of control loop (select output in AL 1)	0…7	0
1AL 1	Select control loop if 1AL 0 = 2,7, Note: max deviation limit is defined in control loop parameters 0 = all active control loops (not valid if 1AL0 = 7) 1 = loop 1 Select run time counter of which binary output if AL 0 = 3, 0 = all binary outputs 1 = Digital output 1 to 5 = Digital output 5 Select fan, binary or analog output if 1AL 0 = 4, 5, 6 0 = function not active 1..x = selected output	0…8	0
1AL 2	Select supervised input if 1AL0 = 1, 4, 5, 6 0 = not active, 1 = UI1 to 8 = VI04 **New Feature:** Select sequence if 1AL0 = 7 0 = heating or reverse 1 = cooling or direct 2 = heating and cooling or reverse and direct	0…8	0
1AL 3	Alarm or interlock mode OFF = Alarm mode active: Icon and the words ALA# on the small digits indicating active alarm will appear on display, reset option in 1AL4 applies. ON = Interlock mode: Outputs revert to normal operation when alarm condition is no longer present, Icon and text indicating active alarm will not appear.	OFF, ON	OFF
1AL 4	Automatic reset or acknowledge to reset (only if AL3 = OFF) OFF = Alarm condition resets automatically. After alarm condition is no longer present, outputs will revert to normal operation, but alarm Icon will continue to blink on display until acknowledged with Option key. ON = Alarm condition must be reset manually. After alarm condition is no longer present, outputs will remain in alarm setting, and Icon will continue to blink on display, until acknowledged with Option key. Note: All alarms operate as well if the controller is in OFF mode. **New Feature:** Select if interlock is active in OFF mode (only if AL3 = ON) OFF = Interlock is not active while controller is in off mode or disabled ON = Interlock is active independent of controller state	OFF, ON	OFF
1AL 5	Delay until alarm is active; **New Feature: Extended time delays**	00:00s...15:10h MM:SS...HH:MM	00:00 MM:SS
1AL 6	Type of alarm (applies only if AL0 = 1, 7) OFF = Low limit alarm ON = High limit alarm Type of feedback (applies only if AL0 = 4, 5, 6) OFF = Direct: Fan on, feedback high ON = Reverse: Fan on, feedback low	OFF, ON	OFF
1AL 7	Alarm limit for input based alarms (applies only if AL0 = 1, 4 to 6) Note: shared value. Changing this input will as well change 1AL9	Per input range	10%
1AL 8	Hysteresis for alarm setback for input based alarms (applies only if AL0 = 1) Note: shared value. Changing this input will as well change 1ALA	Per input range	5%
1AL 9	Alarm limit for sequence based alarms (applies only if AL0 = 7) Note: shared value. Changing this input will as well change 1AL7	0...100%	8%
1AL A	Hysteresis for alarm setback for sequence based alarms (applies only if AL0 = 7) Note: shared value. Changing this input will as well change 1AL8	0...100%	4%

➔ **More Features with V1.2:** 8 alarm functions are available. The highest priority alarm is alarm 1, the lowest one alarm 8.

➔ **New Feature: Feedback alarms for fans, binary and analog outputs (AL0 = 4-6):**
Feedback alarms are deployed to make sure a device is operating correctly. For example to supervise a fan a feedback from a pressure switch may be used. While the fan is in operation, the pressure should be high, if the fan is off, the pressure should be low. If any of these conditions is amiss, after the delay time defined in AL5 expired, an alarm needs to be generated. Feedback alarms normally should not reset themselves automatically. Therefore set AL4 = ON.

➔ **New Feature: Alarms or interlocks for PI sequences of control loops (AL0 = 7)**
Set an alarm or interlock if a sequence of a control loop exceeds a certain level. This may be used to control an output through several control conditions in parallel when applied as interlock or indicate a mal functioning of a control setup when used as alarm. Use limits AL9 and AL10 to define limit and hysteresis for alarms or interlocks for PI sequences.

➔ **Alarm notification or interlock (AL3):**
Low or high limits of inputs may be used to supervise operating conditions when an output should be switched on or off independent of control situations. In this case an alarm display may be unwanted. The display of an alarm can be suppressed by converting the alarm to an interlock by setting AL3 to ON.

➔ **New Feature: Operating the interlock in off mode:**
Normally an interlock should not operate while the controller is in off mode. However, there are exceptions. To activate an interlock in OFF mode, set its AL4 value to ON. Make sure AL4 is set to OFF, if it should not activated an output in OFF mode.

➔ **Alarm automatic reset or acknowledge only *(AL4).***
Certain alarms should automatically reset once the condition is removed, but still keep the end user informed that the alarm condition occurred: A typical example is a frost alarm. If the temperature drops too low, the heat should come on and it should stop again once the frost protection reset temperature is reached.

If an alarm indicates a failure of system equipment that would endanger the operation of a device, the alarm should not automatically reset. For example a fan fails to come on or a pump does not operate. In this case the alarm situation needs to be resolved before restarting the outputs.
By setting AL3 to ON the engineer determines that the alarm must be reset manually before normal operation can continue.

➔ **Alarm delay, alarm limit and alarm reset:**
For the above alarms, an activation delay, a limit and a reset (where applicable) may be defined. The reset determines when the alarm condition will return to normal. It is used with input limit alarms, in frost protection for example. The frost protection alarm is activated once the temperature drops below 5°C (41°F), the alarm reset is set to 5K. The room is now heated until the temperature reaches 5°C (41°F) + 5K = 10°C (50°F). Once this temperature is reached the alarm will switch off, it will remain blinking until acknowledged.

➔ Alarm Settings on Outputs
The position of an output in the event of an alarm may be defined for each output and each alarm individually. The output can be switched on (100%) or off (0%).
Additionally analog outputs may now as well be set to a predefined value. To achieve this, the same alarm needs to be selected in the ON and OFF register. An additional parameter is provided to choose the desired alarm level.

Priority for output control
1. Alarm level low
2. Alarm level high
3. Operation mode OFF
4. Control function

➔ The alarm takes precedence over operating state and control signal. For interlocks, its operation during OFF mode is defined through parameter AL4.

Two parameters define the behavior of the output based on an alarm: One parameter defines which alarm deactivates the output (0%); the other parameter defines which alarm activates the output to 100%. Each alarm can be individually selected. Multiple alarms can be signed to one output. Should an alarm be active simultaneously to activate and another one to deactivate the output, the one to de-activate has precedence.

Control loop configuration

Manipulation of the setpoint

Parameter	Description	Range	Default
1L 00	Select loop control input (0= loop disabled): 1= UI1 to 8= VI04	0–8	1
1L 01	Minimum set point limit heating or winter mode	per input range	0%
1L 02	Maximum set point limit heating or winter mode	per input range	100%
1L 03	Minimum set point limit cooling or summer mode	per input range	0%
1L 04	Maximum set point limit cooling or summer mode	per input range	100%
1L 05	Enable set point compensation. Setpoint compensation is further described in auxiliary function 4FU. 0= disabled 1= winter compensation 2= summer compensation 3= winter and summer	0–3	0
1L 06	Select loop setpoint (0= normal): 1= not applicable 2= not applicable 3= not applicable 4= not applicable **New Feature:** 5= UI1 (percentage of input value is spanned between set point limits) 6= UI2 (percentage of input value is spanned between set point limits) 7= UI3 (percentage of input value is spanned between set point limits) 8= UI4 (percentage of input value is spanned between set point limits) Note: for input based setpoints: input must be set to 0-100% or in potentiometer mode.	0–8	0
1L 07	X_{SBY}: Unoccupied mode setpoint shift If 1L27 = OFF, the occupied setpoint is shifted by the value set with this parameter. The heating set point is reduced and the cooling set point is increased.	Per input range	5%
1L 08	X_{DZ}: Dead zone between displayed set point in 4-pipe mode and acting setpoint **New Feature:** In 4-pipe mode, if both heating and cooling sequences of a loop are enabled, the center setpoint is shown on the display.	Per input range	2%

1L 27	**New Feature**: Fixed set point in unoccupied mode OFF = In unoccupied mode, set point is shifted according to 1L07 ON = In unoccupied mode use minimum set point limit as set point in heating mode or maximum set point limit in cooling mode	ON/OFF	OFF
1L 28	**New Feature:** Set point limits selection based on summer winter OFF = Set point limits follow heat – cool setting of control loop ON = Set point limits follow summer – winter flag (UP 24)	ON/OFF	OFF

➔ **Unoccupied mode setpoints**:
There are two possibilities to change the setpoint in unoccupied mode: Shift it by L07 or switch to the minimum setpoint limit in heating mode and maximum setpoint limit in cooling by setting 1L27 to ON.
Unoccupied mode may be disabled by setting UP06 to OFF.

➔ **Setpoint compensation:**
The setpoint compensation is typically used to compensate the set point due to a change in outside temperature. Enable summer or winter set point compensation for this control loop with L05. Both setpoint shift or setpoint setback are possible. They are described in more detail under auxiliary function 4FU.

➔ **New Feature: Display of setpoint value:**
Depending on the configuration of the controller there are various set points that might be active. If the control loop is in heating only or cooling only setup, this means if only one sequence is enabled, the acting setpoint is shown. If both sequences are enabled, the controller is in 4-pipe mode. In this case the set point shown is the setpoint which lies between the acting heating and cooling setpoints. The distance between the displayed setpoint and the acting setpoint is called dead zone (1L08).
In unoccupied mode, the acting setpoint is shown in all cases.

➔ **New Feature: Summer / winter mode:**
For 4-pipe systems it is useful to control the setpoint limits by a summer – winter flag instead of heating – cooling mode. To have set point limits follow summer winter instead of heating/cooling, enable xL28. Set point limits now follow the setting of UP24 (summer / winter mode).

➔ **New Feature: Controlling the setpoint through a potentiometer or input:**
To use a potentiometer to control the setpoint, select the input with xL06. The selected input must be set to 0-100% or be in potentiometer mode. The value of the input will then be spanned between the upper and lower setpoint limits of the active mode (heating, cooling or summer, winter). A value of 0% of the input will then result in the set point to match the lower limit and a value of 100% results in the setpoint being identical to the upper limit. The values in between are adjusted proportionally.

PI control sequence

Parameter	Description	Range	Default
1L 09	X_{OH}: Offset for heating PI sequence	per input range	0%
1L 10	X_{OC}: Offset for cooling PI sequence	per input range	0%
1L 11	X_{PH}: P-band heating	per input range	2%
1L 12	X_{PC}: P-band cooling	per input range	2%
1L 13	Integral gain heating (0.1 steps) low= slow reaction, high= fast reaction	0–25.5	0.0
1L 14	Integral gain cooling (0.1 steps)	0–25.5	0.0
1L 15	Measuring interval integral (seconds) low= fast reaction, high value= slow reaction	0–255	1 sec.

➔ **Activating control loops**
Control loops and sequences are activated by assigning outputs to them in the output configuration section.

➔ **Proportional control (P-band):**
The proportional control function calculates the output based on the difference between setpoint and input. The proportional band (P-band) defines the difference between setpoint and input required to produce a 100% output. For example: a heating control sequence and a 2.0°C (4.0°F) P-band value will produce a 10V output (100%) when the input temperature is 2.0°C (4.0°F) below setpoint. This is the working range of the proportional control sequence. With 1°C (2°F) below setpoint, the output will be 5V (50%).

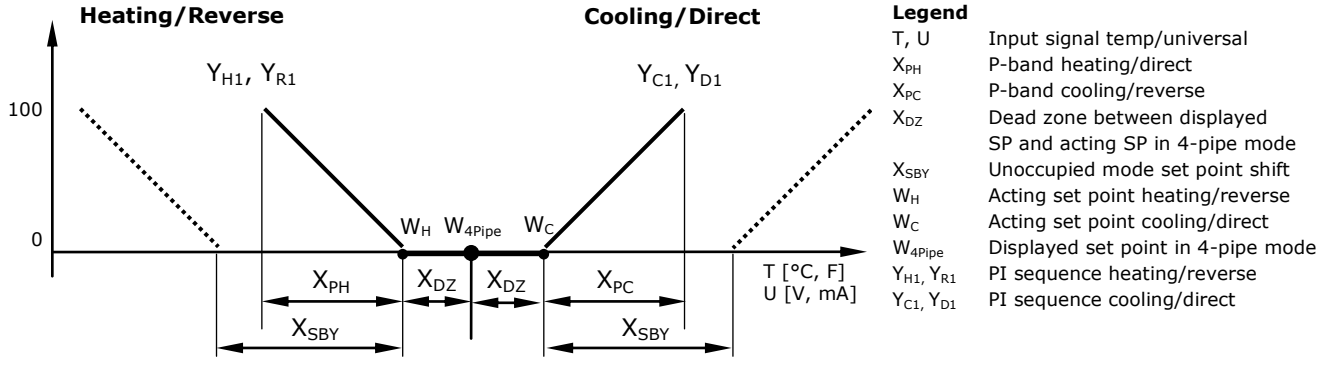
Setting the proportional band to 0 disables proportional control. This is required for very fast control systems such as fan control through air pressure transmitters.

➔ **Integral control:**
Proportional control is in most cases a very stable control mode. The flaw of proportional control alone, however, is that the setpoint is normally not reached. As the measured value gets closer to the setpoint, the output reduces until it reaches a point, a fraction above or below the setpoint, where the output equals the load. To reach the setpoint and achieve a higher level in comfort, the integral function should be activated.

➔ **Integral Gain (KI)** dynamically increases the output by the selected KI value every **Measuring Interval TI** until the setpoint is reached. The challenge is to prevent hunting, where the output increases too fast and the temperature overshoots the setpoint. Hunting may result if the integral gain is too high or measuring interval too short. Each system is different. To prevent instability the P-band should be extended when integral gain is active (L14 or L15 set above 0).

Setting the integral gain to 0 disables integral and differential control.

Recommended Values						
	heating (air)	heating (radiant)	humidifying	cooling	dehumidifying	pressure
P-band	2°C(4°F)	1.5°C(3°F)	10%	1.5°C(3°F)	10%	0
Measuring interval (TI)	2	5	15	1	15	1
Integral gain (KI)	0.2	0.1	0.1	0.2	0.1	0.3



New Feature: Switching binary outputs based on PI sequence:
Binary outputs and fans can now directly correspond to PI levels. In order to achieve this, select the required loop, sequence and switching level with the output parameter of the corresponding binary output or fan.

Digital control sequence

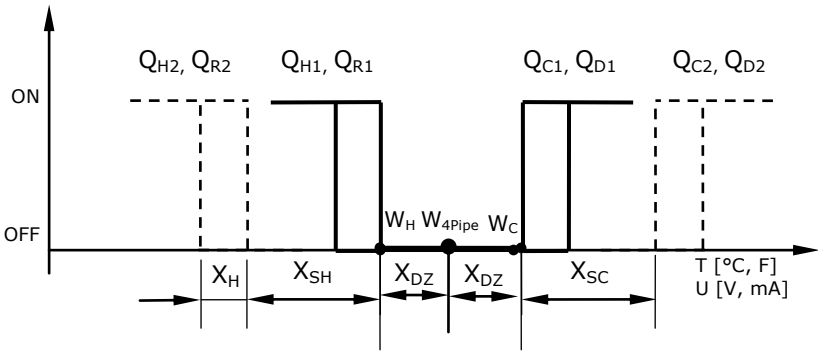
Parameter	Description	Range	Default
1L 16	Action of stages: 0= cumulative: stage 1 stays on when 2 comes on 1= single: stage 1 turns off when 2 comes on 2= digital: stage 1 only, stage 2 only, then stage 1 plus 2	0–2	0
1L 17	X_{OBH}: Offset for heating/reverse binary sequences Offset shifts the acting set point away from the displayed or saved set point	per input	0%
1L 18	X_{OBC}: Offset for cooling/direct binary sequences Offset shifts the acting set point away from the displayed or saved set point	per input	0%
1L 19	X_{SH}: Switching span heating. Switching span is the difference between set point and measured value required for the next binary stage to activate.	per input	2%
1L 20	X_{SC}: Switching span cooling. Switching span is the difference between set point and measured value required for the next binary stage to activate.	per input	2%
1L 21	X_H: Switching hysteresis	per input	0.5%
1L 22	Switching delay min running time for binary stage	0–255s	10s
1L 23	Switching delay min stopping time for binary stage	0–255s	10s
1L 24	Activation of reverse/direct (heat/cool) sequence OFF= activates based on demand ON = follows heat/cool state of controller: Set manually or by auxiliary function (3FU)	ON/OFF	OFF
1L 25	Delay for heat/cool changeover in case above parameter is OFF	00:00s...15:10h MM:SS...HH:MM	05:00 MM:SS
1L 26	Max allowed set point deviation (will generate an alarm if enabled in alarm parameters), Disabled if set to 0.	per input	0.0

➔ Cumulative stage action (L16=0) is typically used in electric heat applications, and single stage action (L16=1) in fan speed applications. Digital stage action (L16=2) is especially useful in electric heat applications to generate three steps with just two outputs. For example: Step 1=100W, step 2=200W, step 3=300W.

	Cumulative	Single	Digital
Stage 1	Q_1	Q_1	Q_1
Stage 2	Q_1+Q_2	Q_2	Q_2
Stage 3			Q_1+Q_2

➔ Switching hysteresis (L21) is the difference between switching on and switching off. A small hysteresis will increase the number of switching cycles and thus the wear on associated equipment.

➔ With minimum running time delay (L22) cumulative stages will not switch on simultaneously. With a sudden demand or initial startup, power stage 2 will not start earlier than 10 seconds (default value) after stage 1 has been initiated. Likewise, after a stage is switched off, it will remain switched off until L23 is expired. This is to avoid rapid switching.



Legend

T, U	Input signal
X_{SH}	Switching span heating/reverse
X_{SC}	Switching span cooling/direct
X_{DZ}	Dead zone between displayed SP and acting SP in 4-pipe mode
W_H	Acting set point heating/reverse
W_C	Acting set point cooling/direct
W_{4Pipe}	Displayed set point in 4-pipe mode
Q_C, Q_D	Binary sequences cooling/direct
Q_H, Q_R	Binary sequences heating/reverse

Output configuration

The binary outputs may be used to control fans, floating point actuators, single stages, or PWM outputs. In case an output is defined for more than one function the following priority applies:

Priority	Physical outputs	DO1	DO2	DO3	DO4	DO5
1	1 fan output up to 3 speeds each:	FAN 1				
		speed 1	speed 2	speed 3		
		1FA 0 ≥ 1	1FA 0 ≥ 2	1FA 0 = 3		
	1 rotation groups:	stage 1	stage 2	stage 3		
2	2 floating point outputs:	FO1		FO2		
		open	close	open	close	
3	5 digital or PWM outputs:	DO1	DO2	DO3	DO4	DO5

Note: FAN1 modules may as well be assigned to analog outputs. In this case DO1 – DO3 for FAN1 will be free for other uses.

Fan and output rotation configuration

Parameter	Description	Range	Default
1F 00	Select the number of fan speeds	0 – 3	0
1F 01	Selection of control loop for fan 0 = Fan output disabled, 1 = Loop 1 2 = not applicable 3 = not applicable 4 = not applicable 5 = Operation mode (on, when operation mode is on, occupied and unoccupied) 6 = Manual positioning/time schedule controlled 7 = Occupied mode (on if occupied, off if unoccupied) New Feature! 8 = not applicable 9 = **New Feature:** Binary output rotation: DO1 → DO2-→ DO3	0 – 9	1
1F 02	Fan outputs select active sequence of control loop if 1F01=1 or select active state of controller if 1F01=5,7: 0 = if 1F01 = 1: Heating, Reverse 1 = if 1F01 = 1: Cooling, Direct 2 = if 1F01 = 1: Heating and Cooling (2 pipe system) 3 = if 1F01 = 5,7: Demand based on Heating, Reverse 4 = if 1F01 = 5,7: Demand based on Cooling, Direct 5 = if 1F01 = 5,7: Demand based on Heating and Cooling	0 – 5	2
	When F01 = 6: Manual positioning/time schedules 0 = Allow time schedule only 1 = Allow manual positioning and time schedules		
	New Feature: When 1F01 = 9: Output rotation Define number of simultaneous active outputs. If set to 0 or 1, then only one output will be active at the same time, if set to 2 than 2 outputs will be active at each time. For this to work at least 3 outputs must be activated.		
1F 03	**New Feature!** Fan behavior when setpoint is satisfied if 1F01 = 1-8: 0 = Fan off when no demand 1 = Lowest fan speed on when occupied. Fan switches off when not occupied. 2 = Lowest fan speed on in cooling mode. Fan switches off in heating mode. 3 = Lowest fan speed on when operation mode on, occupied and unoccupied (mold protection)	0...3	0
	New Feature with V1.2R4! In output rotation mode (1F01 = 9): Step length of 1F15 0 = Steps defined in 1F15 are counted in minutes 1 = Steps defined in 1F15 are counted in hours 2 = Steps defined in 1F15 are counted in days (24h)		
1F 04	Startup delay: Delay before starting fan. Other control outputs connected to the same control loop are disabled during startup delay. **New Feature**: Extended delays	00:00s...15:10h MM:SS...HH:MM	00:00s MM:SS
1F 05	Switch off delay: If the fan should extend its run time after the control valves are closed. Set the time to extend fan run time after control outputs switch off. **New Feature**: Extended delays	00:00s...15:10h MM:SS...HH:MM	00:00s MM:SS
1F 06	Choose alarms to set fan to 100%. In case of conflicting alarms, the fan will be switched off. See section alarms for further details. ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽
1F 07	Choose alarms to switch off fan. See section alarms for further details. ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽

➔ The active fan speed is defined by the binary sequence of the control loop (L17-L23) or if 1F10= ON the output of the PI sequence of this control loop.
Automatic fan speeds can be overridden by keypad if manual mode is enabled (UP02 = ON). If fan should be manually disabled 1F08 need to be set to ON.

➔ Demand based functions: The fan will start automatically in case there is a demand on the heating or cooling sequence of a specific control loop (defined in 1F01) or the controller if 1F01=5. Startup and switch off delays will apply.

Fan output settings for manual control

Parameter	Description	Range	Default
1F 08	**New Feature: Manual fan switch off mode** When 1F01 = 1-4 or 6:Manual switch off of fan OFF = Fan may not be switched off manually while assigned to control loop ON = Fan can be set to off manually while assigned to control loop	ON/OFF	OFF
	New Feature: Manual control of output rotation When 1F01 = 9: Output rotation OFF = Rotation may not be controlled manually ON = Rotation can be controlled manually Note: setting an output to manual while in output rotation mode, will interrupt output rotation indefinite until set back to auto mode.		
1F 09	Not used	ON/OFF	OFF

Fan output configuration in PI mode (1F10 = ON)

Parameter	Description	Range	Default
1F10	**New Feature:** Use PI sequence as input for fan (not binary sequence)	ON/OFF	OFF
1F11	Limit for fan speed 1 if 1F10 = ON Note: Shared parameter: Changing this value, will as well change 1F15.	0...100%	20%
1F12	Limit for fan speed 2 if 1F10 = ON Note: Shared parameter: Changing this value, will as well change 1F16.	0...100%	50%
1F13	Limit for fan speed 3 if 1F10 = ON Note: Shared parameter: Changing this value, will as well change 1F17.	0...100%	80%
1F14	Hysteresis for fan speeds if 1F10 = ON	0...100%	15%

Fan output configuration for output rotation (1F01 = 9)

Parameter	Description	Range	Default
1F15	**New Feature:** In output rotation mode (1F01 = 9): Running time in minute, hours or days. (Set with 1F03)**.** While in auto mode, the controller will switch to the next output after this time has expired. Note: Shared parameter: Changing this value, will as well change 1F11.	0...255	50
1F16	**New Feature:** If 1F01 = 9: Current active output (1-3) Note: Shared parameter: Changing this value, will as well change 1F12.	0-3	-
1F17	**New Feature:** If 1F01 = 9: Run time in minute, hours or days (set with F03) for current of output since last switch. Note: Shared parameter: Changing this value, will as well change 1F13.	0....255	-

➔ With manual positioning (1F01=6) control the fan by time schedule or manually. Setting 1F02=0 will disable manual positioning through the operation terminal. The fan will then only be controlled by time schedule. Set F02=1 to allow manual positioning.

➔ **Alarm or interlock selection:**
Every may be activated or deactivated based on a series of alarms or interlocks. Alarms specify fault conditions of the control application; interlocks may be used to offer additional control options. Alarms operate as well when the controller is in off mode. Interlocks can be selected to be active in off mode or not.
To activate the output while an alarm is pending, select the alarm in F07. To deactivate the output with the alarm pending, select it in F08. If both an alarm is active which is selected in F07 and another alarm is active that is selected in F08, the output will be switched off.

➔ **New Feature: Fan output in PI mode**
Switch fan based on PI sequence rather than binary sequence of control loop. Select control loop and sequence with parameters 1F01 and 1F02, set 1F10 = ON and define switching limits for different fan speeds with 1F11 to 1F13. The hysteresis for all fan speeds is identical and is set with F14.

➔ **New Feature: Rotation of binary outputs:**
The fan module may be used to rotate a group of binary outputs based on their run time. This is commonly used with pumps or where multiple devices control one function. To use output rotation, activate it by selecting number of outputs involved with F00, choose function by setting 1F01 = 9. The number of simultaneous active outputs is set with 1F02 (1 or 2). Choose running time step size with 1F03 for minutes, hours or days and set running time of each output with 1F15 (Step size may only be defined with V1.2R4 and later).
The fan 1 module in rotation mode will disable all outputs of loop 1, while outputs are switching. The fan 2 module will switch off outputs of loop 2 while switching its outputs. This way variable speed controllers may be disabled. Select if manual control is allowed with 1F08. The current active output may now be seen in 1F16, the current running time since the last switch is visible with 1F17. These settings and times may be changed through access to parameters.
Note: Parameters 1F10 to 1F14 may change while this mode is active.

Floating output configuration

Parameter	Description	Range	Default
1d 00	Enable digital or floating point output 1d00 = OFF: DO1, DO2 are two digital/PWM outputs 1d00 = ON : DO1, DO2 is one floating point output (DO1 open, DO2 close)	ON/OFF	OFF
1d 01	Select control loop or special function (0= OFF) 1 = Loop 1 2 = not applicable 3 = not applicable 4 = not applicable 5 = Economizer (Free heating and cooling) 6 = Manual positioning/time schedule controlled 7 = Controller state functions 8 = not applicable 9 = **New Feature:** Proportional function: Output assigned to an input	0–9	0
1d 02	When 1d01=1-4 configure output: 0= Heating/reverse 1= Cooling/direct 2= Heating and cooling (2 pipe) **New Feature:** 3= Fully open if loop in heating mode: Used for reversing valves 4= Fully open if loop in cooling mode: Used for reversing valves	0–10	0
	When 1d01=5, select function: 0 = not applicable. 1 = Economizer: Outdoor air damper actuator. See 5FU for more details. 2 = Economizer: Return air damper actuator. See 5FU for more details.		
	When 1d01 = 6 Manual positioning/time schedules 0 = Allow time schedule only 1 = Allow manual positioning and time schedules		
	When 1d01=7 select state functions: 0= ON if controller operation state is ON 1= ON while demand on any output 2= ON while controller in heating mode 3= ON while controller in cooling mode 4= ON if controller state is occupied, OFF if unoccupied		
	New Feature: When 1d01 = 9: Select input for proportional function. Minimum and maximum limits are defined with 1d14 and 1d15: 0 = not active, 1 = UI 1 to 10 = VI04		
1d 03	**New Feature:** When 1d01=6, 7 and 9: Select reaction on on/off/disable operation mode 0 = output is off, when operation mode is off 1 = output is off, when operation mode is disabled 2 = operation mode has no effect on output	0-7	0
1d 04	Running time (Time for actuator to run from fully open to fully close)	00:00s...15:10h MM:SS...HH:MM	00:00
1d 05	Switching difference for floating point signal: to reduce the switching frequency of the actuator. The actuator will only move if the running time to move the actuator from its current position to the target position is larger than this parameter.	00:00s...15:10h MM:SS...HH:MM	00:05

This table is continued on next page.

➔ With manual positioning (d01=6) position the output by time schedule or manually (0…100% in 0.5% steps). Setting d02 to 0 will disable manual positioning. The output will then only be controlled by time schedule. Set d02 to 1 to activate manual control of the output.

➔ For floating point outputs the running time of the actuator used needs to be specified with 1d04. Running time is defined as the time required for the actuator to run from fully open to fully closed and vice versa. Actuators with a fixed running time are recommended. Once fully open or fully closed the running time for the actuator is extended for a full run-time cycle. This will allow the actuator position to be synchronized in case it has been moved during off time or an actuator with variable running time was used.

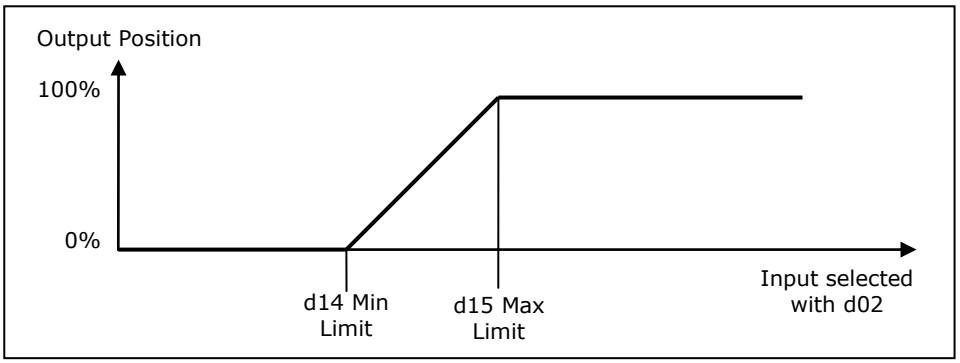
➔ State functions (1d01=7) fully open the output based on certain conditions with or without a demand for heating or cooling. In Energy Hold OFF mode (EHO) the output will be off.
Note: From V1.2R6 onwards, this function is combined with d03.

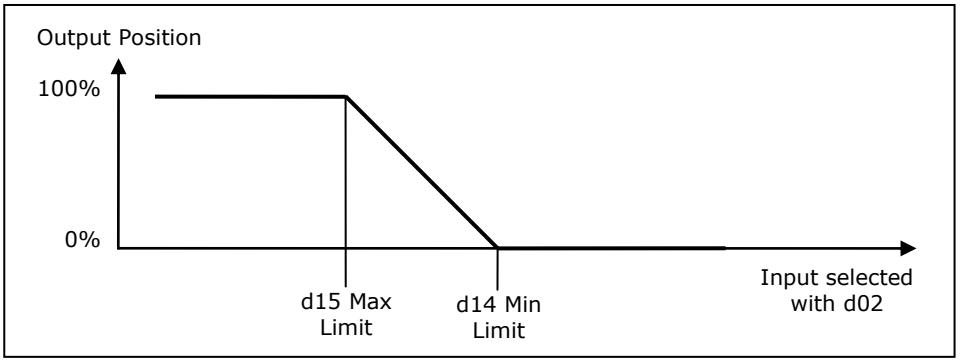
Floating outputs configuration continued

Parameter	Description	Range	Default
1d 06	Not used		
1d 07	Choose alarm to set output to 100% (output 0% on conflicting alarms) ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽
1d 08	Choose alarm to set output to 0% (output 0% on conflicting alarms) ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽
1d 09	Not used	ON/OFF	OFF
1d 10	Not used	0…12750h	0
1d 11	Not used	ON/OFF	OFF
1d 12	Not used	0...100%	0%
1d 13	Not used	0...100%	0%
1d 14	Proportional function based on input (1d01 = 9): Minimum limit : If 1d15 > 1d14: when input value is above this limit, output starts to increase. If 1d15 < 1d14: when input value is below this limit, output starts to increase. Note: shared parameter: changing this value, will change as well 1d12	0...100%	0%
1d 15	Proportional function based on input (1d01 = 9): Maximum limit : If 1d15 > 1d14: when input value is above this limit, output is at 100%. If 1d15 < 1d14: when input value is below this limit, output is at 100%. Note: shared parameter: changing this value, will change as well 1d13	0...100%	0%

➔ **Alarm or interlock selection:**
Every may be activated or deactivated based on a series of alarms or interlocks. Alarms specify fault conditions of the control application; interlocks may be used to offer additional control options. Alarms operate as well when the controller is in off mode. Interlocks can be selected to be active in off mode or not.
To activate the output while an alarm is pending, select the alarm in d07. To deactivate the output with the alarm pending, select it in d08. If both an alarm is active which is selected in d07 and another alarm is active that is selected in d08, the output will be switched off.

➔ **New Feature: Proportional function based on input:**
The position of a floating output may be based on an input value. The input is selected with d02. Two limits define the proportional range: A minimum and a maximum limit. Depending on this limits the output may be opened with a sinking or a rising input signal.





Binary output configuration (d00=OFF)

Parameter	Description	Range	Default
1d 01	Select control loop or special function (0= OFF) 1 = Loop 1 2 = not applicable 3 = not applicable 4 = not applicable 5 = Economizer (Free heating and cooling) 6 = Manual positioning/time schedule controlled 7 = Controller state functions 8 = **New Feature:** Max of loop 1 and loop 2 9 = **New Feature:** Binary output assigned to an input	0–9	0
1d 02	When 1d01=1-4 configure output: 0= Heating/reverse 1= Cooling/direct 2= Heating and cooling (2 pipe) **New Feature:** 3= Fully open if loop in heating mode: Used for reversing valves 4= Fully open if loop in cooling mode: Used for reversing valves	0–8	0
	When 1d01=5, select function: 0 = Not applicable 1 = Economizer: Outdoor air damper actuator. See 5FU for more details. 2 = Economizer: Return air damper actuator. See 5FU for more details.		
	When 1d01 = 6 Manual positioning/time schedules 0 = Allow time schedule only 1 = Allow manual positioning and time schedules		
	When 1d01=7 select state functions: 0= ON if controller operation state is ON 1= ON while demand on any output 2= ON while controller in heating mode 3= ON while controller in cooling mode 4= ON if controller state is occupied, OFF if unoccupied NEW!		
	New Feature: When 1d01 = 9: Select input for switch function. Switching limits are defined with 1d14 and 1d15: 0 = not active, 1 = UI 1 to 8 = VI04		
1d 03	When 1d01=1: Select sequence 0 = Operation mode, Output is active when mode is active 1 = binary mode: Stage 1 to 6 = binary mode: Stage 6	0-6	0
	New Feature: When 1d01=6, 7 and 9: Select reaction on on/off/disable operation mode 0 = output is off, when operation mode is off 1 = output is off, when operation mode is disabled 2 = operation mode has no effect on output		
1d 04	Switch off delay: **New Feature**: Extended delays Time the output signal needs to be off, before output switches off	00:00s...15:10h MM:SS...HH:MM	01:30
1d 05	Switch on delay: **New Feature**: Extended delays Time the output signal needs to be on, before output switches on. With state functions, all control outputs are disabled during switch ON delay.	00:00s...15:10h MM:SS...HH:MM	00:05
1d 06	Activate PWM, set cycle time, seconds (>0 activates, 0 deactivates) **New Feature**: Extended time setting range	00:00s...15:10h MM:SS...HH:MM	00:00

➔ State functions (1d01=7) activate the output based on certain conditions with or without a demand for heating or cooling, in either occupied or unoccupied mode. In OFF mode the output will be off.
Note: From V1.2R6 onwards, this function is combined with d03.

➔ With manual positioning (1d01=6) position the output by time schedule or manually (ON, OFF or 0…100% in 0.5% steps for PWM outputs). Setting 1d02 to 0 will disable manual positioning. The output will then only be controlled by time schedule. Set 1d02 to 1 to activate manual control of the output.

➔ Pulse width modulation (PWM) mode is enabled with 1d06. In PWM mode the digital output will be switched on/off once per cycle. The on and off times are calculated according to the PI settings of the respective control sequence. It is not recommended to use cycle times below 10 Minutes for relays outputs as the lifetime of the relays will be shortened with frequent switching.

Binary output configuration continued

Parameter	Description	Range	Default
1d 07	Choose alarm to set output to ON (output OFF on conflicting alarms) ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽
1d 08	Choose alarm to set output to OFF (output OFF on conflicting alarms) ▽▽▽▽▽▽▽▽ Alarm: 1 2 3 4 5 6 7 8	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽
1d 09	d09 and d10 only function if output is in binary mode: OFF: Do not count run time and reset counter to 0 ON: Count run time in hours while a binary output is switched on	ON/OFF	OFF
1d 10	Trigger function alarm when run time is reached (may be used as maintenance alarm), 0 = alarm disabled	0…12750h	0
1d 11	**New Feature:** Uses PI sequence instead of binary sequence of PI loop Note: changing this value, will automatically as well change 1d13.	ON/OFF	OFF
1d 12	Activation limit if based on PI (1d01 = 1-4 AND 1d11 = ON), if value above this limit, output switches on. Note: shared parameter: changing this value, will change as well 1d14	0...100%	50%
1d 13	Deactivation limit if based on PI (1d01 = 1-4 AND 1d11 = ON), if value below this limit, output switches off. Note: shared parameter: changing this value, will change as well 1d15	0...100%	40%
1d 14	Activation limit if based on UI (1d01 = 9: if value is above this limit, output switches on. Note: shared parameter: changing this value, will change as well 1d12	0...100%	50%
1d 15	Deactivation limit if based on UI (1d01 = 9: if value is below limit, output switches off. Note: shared parameter: changing this value, will change as well 1d13	0...100%	10%

➔ **Alarm or interlock selection:**
Every may be activated or deactivated based on a series of alarms or interlocks. Alarms specify fault conditions of the control application; interlocks may be used to offer additional control options. Alarms operate as well when the controller is in off mode. Interlocks can be selected to be active in off mode or not.
To activate the output while an alarm is pending, select the alarm in d07. To deactivate the output with the alarm pending, select it in d08. If both an alarm is active which is selected in d07 and another alarm is active that is selected in d08, the output will be switched off.

➔ **Run time counter (d09):**
Run time counters can be used to sum up the accumulated runtime of a device connected to a binary output. The counter runs up to 65536 hours and saves the run time every hour to EEPROM. The run time hours and the status of the binary output will be displayed when stepping through the available display pages with the operation terminal.

➔ **Maintenance alarm (d10):**
The run time counter may be used to trigger a maintenance alarm once a certain run time is exceeded. Select limit to trigger a maintenance alarm. The limit is selectable in steps of 256 hours. Setting the time to 0 disables the maintenance alarm. Note: An alarm must be assigned to maintenance alarm by setting AL0 = 3 on one alarm.

➔ **New Feature: Switch binary output based on PI-sequence:**
This New Feature allows a direct response to PI output value. So no alarms or interlocks have to be used for a simple limit switch. Switch output based on PI sequence rather than binary sequence of control loop. Select control loop and sequence with parameters d01 and d02, set d11 = ON and define switching limits with d12 and d13.

➔ **New Feature: Switch binary output based on input value:**
Activate the function with d01 = 9. Select the input with d02 and define the switching limits with d14 and d15. Reversing the switching limits, will reverse the switching function of the output.
Note: The switch based on inputs is as well used for the light switch function.

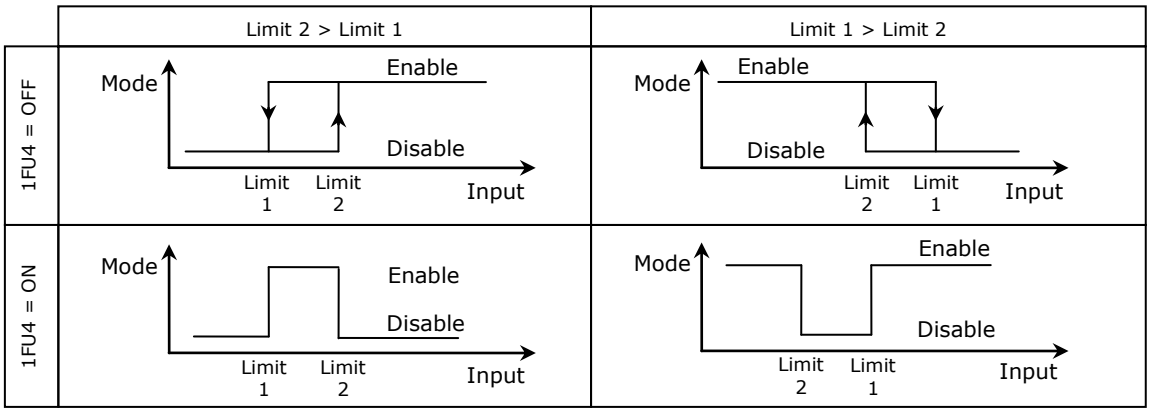
Auxiliary functions

1FU Enable/disable of controller based on inputs and alarm conditions

Parameter	Description	Range	Default
1Fu 0	Select input for remote enable function: 0 = not active, 1 = UI 1 to 8 = VI 4	0…8	0
1Fu 1	Manual override permitted (without waiting for delay). This function allows overriding of the enable conditions by manually starting the controller; The controller will switch off again if the running conditions are not met until the disable delay is expired. This function is required, where the controller needs to create the allowed input condition for example by running a fan while differential pressure is used as enable condition.	ON/OFF	OFF
1Fu 2	Enable delay (seconds) = the time the enable condition must be met before the controller is enabled **New Feature**: Extended delays	00:00s...15:10h MM:SS...HH:MM	05:00 MM:SS
1Fu 3	Disable delay (seconds) = the time the disable condition must be met before the controller is disabled **New Feature**: Extended delays	00:00s...15:10h MM:SS...HH:MM	05:00 MM:SS
1Fu 4	Range of limits (See table below for graphical explanation): OFF = When limit 2 (e.g. 60) is larger than limit 1 (e.g. 40) the controller will be enabled when the input value is greater than limit 2 (e.g. 60) and disabled when the input value is below limit 1 (e.g. 40). When limit 2 (e.g. 40) is lower than limit 1 (e.g. 60) the controller will be enabled when the input value is lower than limit 1 (e.g. 40) and disabled when the input value is above limit 2 (e.g.10). ON = When limit 2 (e.g. 60) is above limit 1 (e.g. 40) the controller will be enabled when the input value is between limit 1(e.g. 40) and limit 2 (e.g. 60). When limit 2 (e.g. 40) is below limit 1 (e.g. 60) the controller will be enabled when the input value is below limit 2 (e.g. 40) or above limit 1 (e.g. 60).	ON/OFF	OFF
1Fu 5	Input limit 1 (See 1Fu 4 for description)	per input range	10
1Fu 6	Input limit 2 (See 1Fu 4 for description)	Per input range	90
1Fu 7	Disable controller in case of selected alarms are active Note: Switch-off delays still apply when an alarm becomes active	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽

➔ Enable or disable the controller based on high or low input limits and alarm status. The alarm status register may be used as *and* function where several conditions must be met before the controller is allowed to function.

➔ Time schedules do not override the enable function.



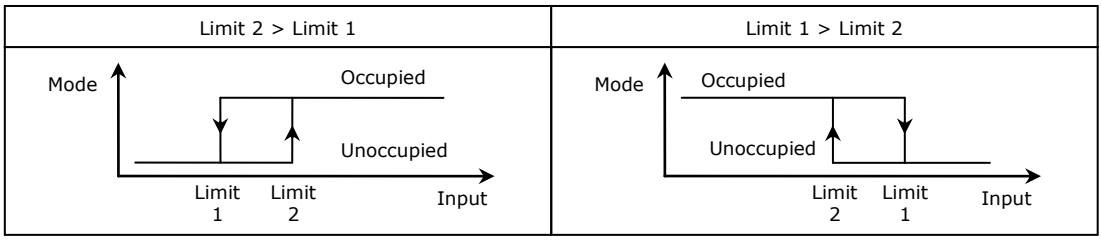
2Fu – Switch occupied and unoccupied modes based on input values

2Fu 0	Select input for remote occupied – unoccupied change function: 0 = not active, 1 = UI 1 to 8 = VI 4	0–8	0
2Fu 1	Unoccupied mode delay (seconds) = the time the input needs to be inactive before the controller switches to unoccupied mode. **New Feature**: Extended delays	00:00s...15:10h MM:SS...HH:MM	05:00 MM:SS
2Fu 2	Input limit 1 to signal unoccupied or door opened	per input range	10
2Fu 3	Input limit 2 to signal occupied or door closed	Per input range	90
2Fu 4	Select input for door contact in combination with input defined under 2Fu 0: 0 = not active, 1 = UI 1 to 8 = VI 4 If door contact input is defined, the controller will only go to unoccupied mode, if the door is opened and after the door closes, there is no movement registered on the input selected in 2Fu 0	0–8	0
2Fu 5	**New Feature** Select interlocks or alarms for window contact. If any interlock activates, the function will change to unoccupied mode, independent of door state.	Triangle shown = alarm selected	▽▽▽▽▽▽▽▽

➔ Use occupied/unoccupied mode changeover with key card switches, occupancy sensors, etc.
Activate function by selecting the input to control occupied/unoccupied mode. Set the limits (2FU2 and 2FU3) to the input values that indicate when the room is occupied or unoccupied. This can be done through a switch or for example a CO2 sensor.
Configure occupied/unoccupied changeover with loop configuration parameter 1L07 and 1L27 for each affected control loop.

➔ **New Feature:** For door contact applications: The use of a key switch may be avoided by using a door contact and a motion detector. The motion detectors should be placed in each room in order to detect the presence of an occupant. The room will automatically go to unoccupied mode once the door is opened and closed again and if there is no movement in the room after the door closes. The delay of the motion detector MUST therefore be less than the unoccupied mode delay defined with 2FU1; else the controller will stay in occupied mode. Ideal is to keep the delay of the motion detector output to below 30 seconds.
The moment there is movement in the room or the door is opened; the room will go to occupied mode again and will not go to unoccupied unless the door is opened and closed again.

➔ Following are the occupied/unoccupied mode switch possibilities:

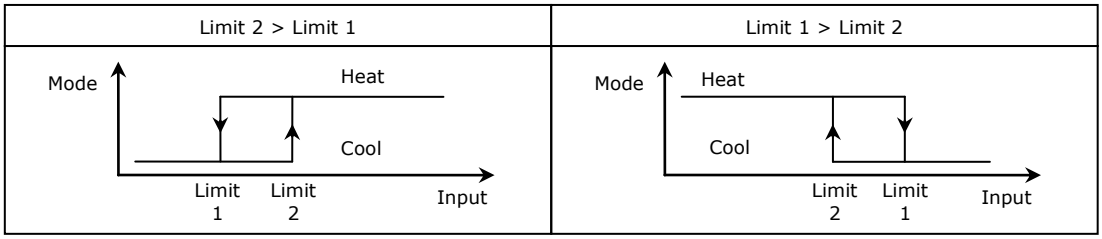


3Fu – Switch heating and cooling state based on input values

Parameter	Description	Range	Default
3Fu 0	Select input for remote heat – cool change function: 0 = not active or based on control loop, 1 = UI 1 to 8 = VI 4	0…8	0
3Fu 1	If heat – cool is based on a control loop, select control loop here (3Fu 0 must be set to 0) 0 = not active or based on universal input 1 = Based on heat – cool status of control loop 1 2 = not applicable 3 = not applicable 4 = not applicable	0…4	0
3Fu 2	**New Feature: extended delays:** Activation delay (Seconds) = delay before heat – cool mode is switched. This delay is to avoid unnecessary switching	00:00s...15:10h MM:SS...HH:MM	05:00 MM:SS
3Fu 3	Input limit 1 (Cool limit) applies only if based on input	Per input range	20%
3Fu 4	Input limit 2 (Heat limit) applies only if based on input	Per input range	40%

➔ The heating or cooling state of the controller may be controlled from a central location by a binary (digital) contact or temperature levels of outside air or supply media. The state may also depend on heating or cooling demand of a control loop. Note: The control loop used to determine the heat /cool state must be set to demand-based heating and cooling with (L24 = OFF).

➔ Set limit 1 and limit 2 to switch between heating and cooling with options below:



➔ When switching heating/cooling state with an external switch set input to RT/DI mode and connect switch to signal ground. Ground levels of all involved controllers must be the same.

➔ For supply media temperature we recommend switching to cooling at limit1 = 16°C/61°F and to heating at limit2 = 28°C/83°F. For outdoor temperature we recommend switching to cooling at limit1 = 28°C/83°F and to heating at limit2= 16°C/61°F outdoor temperature.

➔ Above recommendations are given as suggestions. The ideal settings may be different on the actual project depending on climatic and system conditions.

4FU Summer/winter compensation of control loop setpoints

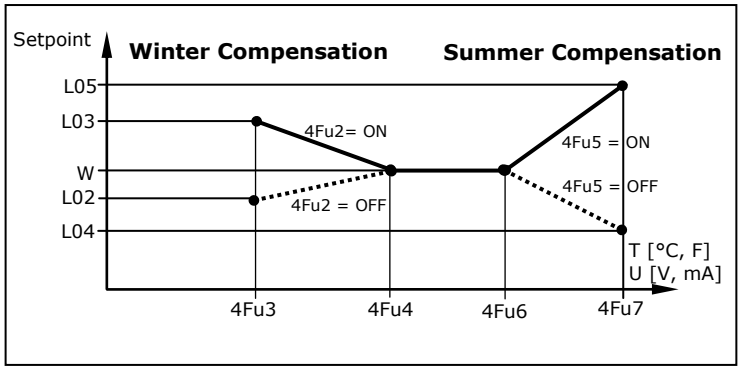
Parameter	Description	Range	Default
4Fu 0	Selection of Compensation Input 0 = not active, 1 = UI 1 to 8 = VI 4	0…8	0
4Fu 1	Type of compensation OFF = Offset: The setpoint shifts up or down based on an input signal ON = Setback: The setpoint is shifted towards loop setpoint min max based on an input signal.	ON, OFF	OFF
Offset setpoint compensation: 4Fu1 = OFF			
4Fu 2	Shift is direct or reverse acting OFF = Direct: Rising input value increases setpoint ON = Reverse: Rising input value decreases setpoint	ON, OFF	OFF
4Fu 3	Input span required to shift setpoint one step: For example: An 4Fu3 value of 5% for a control loop set point with 0.5°C steps will change the set point by 0.5° for every 5% that the compensation input changes.	Per input range	10
4Fu 4	Input where setpoint shift is = 0, This defines the value of the input signal where the control set point is not compensated	Per input range	50
Setback setpoint compensation: 4Fu1 = ON			
4Fu 2	Winter Compensation: OFF = setpoint is shifted negative to lower setpoint limit ON = setpoint is shifted positive to upper setpoint limit	ON, OFF	OFF
4Fu 3	Winter Compensation (Setpoint shift with low compensation signal) Lower Limit: input signal with maximum setpoint shift	Per input range	10
4Fu 4	Winter Compensation (Setpoint shift with low compensation signal) Upper Limit: Input signal at begin of setpoint shift.	Per input range	50
4Fu 5	Summer Compensation: OFF = setpoint is shifted negative to lower setpoint limit ON = setpoint is shifted positive to upper setpoint limit	ON, OFF	ON
4Fu 6	Summer Compensation (Setpoint shift with high compensation signal) Lower Limit: input signal at begin of setpoint shift	Per input range	60
4Fu 7	Summer Compensation (Setpoint shift with high compensation signal) Upper Limit: Input signal with maximum setpoint shift.	Per input range	80
4Fu 8	Hot / Cool Symbol while compensation is active OFF= Hide symbol ON= Show symbol	ON, OFF	OFF

➔ Summer/winter compensation changes the set point due to a change in an input value, typically, but not limited to, an outdoor temperature input. Activate summer/winter compensation with control loop configuration parameter (L05).

➔ For setpoint setback: Winter compensation starts when outside temperature drops below the upper limit of winter compensation (4FU4). At maximum winter compensation the actual set point will be equal to the control loop's minimum or maximum heating set point depending on the setting of 4FU2. Summer compensation starts when outside temperature exceeds the lower limit for summer compensation (4FU5). At maximum summer compensation the actual set point will be equal to the control loop's minimum or maximum cooling set point depending on 4FU5.

➔ Setting 4FU8 = ON indicates the state of compensation on the display by showing a heat – cool symbol.

Set point set back
4FU1 = ON



5Fu: Economizer (free heating or cooling), NEW algorithm!

Parameter	Description	Range	Default
5Fu 0	Assign Economizer to a control loop 0 = economizer function is disabled 1 = assigned to control loop 1 2 = not applicable 3 = not applicable 4 = not applicable	0...4	0
5Fu 1	Assign free heating or/and free cooling options 0 = economizer is disabled 1 = free heating is enabled 2 = free cooling is enabled 3 = free heating and free cooling is enabled	0..3	0
5Fu 2	Outdoor air sensor input (Temperature or Enthalpy): 0 = not active, 1 = UI 1 to 8 = VI 4	0..8	0
5Fu 3	Return air sensor input (Temperature or Enthalpy): 0 = not active, 1 = UI 1 to 8 = VI 4	0..8	0
5Fu 4	If temperature sensors are used: Choose difference between outside air temperature and loop setpoint required to activate free heating or cooling If enthalpy sensors are used: Choose difference between outside air enthalpy and return air enthalpy required to activate free heating or cooling	Per input range	0
5Fu 5	Delay time in minutes to activate mechanical heating or cooling in case supply air set point cannot be reached through free heating or cooling.	0…255	30
5Fu 6	Disable economizer in case one of the selected interlocks/alarms is active. The interlocks may be assigned to outdoor humidity or pollution sensors	Triangle shown = interlock selected	▽▽▽▽▽▽▽▽

➔ The aim of the economizer function is to reduce energy consumption by utilizing situations where cooling or heating requirements may be satisfied or supported by outdoor air.

➔ To operate, the economizer needs to be assigned to a control loop. There are several possibilities to determine if the condition for free heating or cooling is satisfied. The economizer operates differently depending on the sensors attached to it.

➔ Outdoor air enthalpy, return air enthalpy:
Once there is heating or cooling demand, the economizer compares the enthalpy of return air with outdoor air. If the minimum difference condition defined with 5FU4 is met, mechanical heating or cooling is deactivated and the outdoor and return air dampers are modulated to achieve the predefined set point of the supply air. Mechanical cooling will resume, if the setpoint is not reached during the time specified in 5FU5.
The outdoor damper will remain open, as long as the outdoor enthalpy is below the return air enthalpy for free cooling or above it for free heating.

➔ Outdoor air temperature, return air temperature:
Once there is heating or cooling demand, the economizer compares the setpoint with the outdoor air and return air temperature. If the minimum difference condition defined with 5FU4 is met, mechanical heating or cooling is deactivated and the outdoor and return air dampers are modulated to achieve the predefined set point of the supply air. Mechanical cooling will resume, if the setpoint is not reached during the time specified in 5FU5.
The outdoor damper will remain open, as long as the outdoor temperature is below the return air temperature for free cooling or above it for free heating.
With 5FU6 an interlock may be used to disable the economizer if the outdoor air humidity or outdoor air pollution is for too high to provide free cooling.

➔ Outdoor air temperature only:
Once there is heating or cooling demand, the economizer compares the setpoint with the outdoor air temperature. If the minimum difference condition defined with 5FU4 is met, mechanical heating or cooling is deactivated and the outdoor and return air dampers are modulated to achieve the predefined set point of the supply air. Mechanical cooling will resume and outdoor damper will return to minimum position, if the setpoint is not reached during the time specified in 5FU5.
With 5FU6 an interlock may be used to disable the economizer if the outdoor air humidity or outdoor air pollution is for too high to provide free cooling.

Communication configuration

Parameter	Address	Description	Range	Default
CO 00	13000	Bus plug-in id (read only)	0…255	1
CO 01	13001	Bus plug-in software version (read only)	0…255	-
CO 02	13002	Bus plug-in software revision (read only)	0…255	-
CO 03	13003	Communication address (must be unique in network)	1…127	1
CO 04	13004	Baud rate: 0 = **19200** 1 = 4800 2 = 9600 3 = 19200 4 = 38400	0…255	0
CO 05	13005	Parity mode 0 = NO Parity 1 = **EVEN Parity** 2 = ODD Parity	0…255	1
CO 06	13006	Mode of communication 0 = **RTU** 1 = ASCII	0…255	0
CO 07	13007	Allow changing of static settings through communication 0 = Not allowed 1 = **Allowed**	0…255	1
CO 08	13008	Modbus address base mode **0 = Modbus addresses are "Base 0"** 1 = Modbus addresses are "Base 1" (PLC style)	0…255	0
CO 09	13009	User definable data storage address 00	0…255	255
CO 10	13010	User definable data storage address 01	0…255	255
CO 11	13011	User definable data storage address 02	0…255	255
CO 12	13012	User definable data storage address 03	0…255	255
CO 13	13013	Not used	0…255	255
CO 14	13014	Not used	0…255	255
CO 15	13015	Automatic address increase. If enabled the address will automatically increase when parameters are automatically loaded at power up using AEC-PM1 in auto load mode. This is useful when setting up controllers for a large network. This way the installer will not have to login manually and set the network address for each controller. 0 = Auto increment function disabled 1 = Auto increment function is enabled	0…1	0

➔ **Automatic address increase function:**
When this function is enabled and an automatic AEC-PM1 parameter load is executed at power up of the controller, the communication address on CO03 is incremented and written back to the AEC-PM1 unit.
It is incremented only if the value is not already 127.

➔ **Changing address register through broadcast message:**
It is not possible to change network address register through broadcast message.

Dynamic Modbus Address list

Controller information

Address	Description	Range	R/W
1000	Product series information	8Bit	R
1001	Product type information	8Bit	R
1002	Controller Firmware Version	8bit	R
1003	Controller Firmware Revision	8bit	R
1004	Type of controller	16bit	R
1005	Number of control loops	16bit	R
1006	Number of binary inputs	16bit	R
1007	Number of universal inputs	16bit	R
1008	Number of virtual inputs	16bit	R
1009	Number of binary outputs	16bit	R
1010	Number of analog outputs	16bit	R
1011	Number of fan outputs	16bit	R
1012	Number of floating outputs	16bit	R
1013	Number of alarms	16bit	R
1014	Number of auxiliary functions	16bit	R
1015	Number of time schedules	16bit	R
1016	Number of switching times / time schedule	16bit	R

Controller state

1050	Operation State ON 0 = OFF, 1 = ON	1bit	R/W
1051	Operation state Standby – Comfort 0 = **Comfort**, 1 = Standby	1bit	R/W
1052	Operation State Heat – Cool 1 = **Heat**, 0 = Cool	1bit	R/W
1053	Operation state Celsius – Fahrenheit 0 = **Celsius**, 1 = Fahrenheit	1bit	R/W
1054	Operation state Fan Only 0 = **Fan Only disabled** 1 = Fan Only enabled	1bit	R/W
1055	Operation state Enable Time Schedules 0 = **Time Schedules disabled** 1 = Time Schedules enabled	1bit	R/W

Clock setting

1080	Century (0…99)	BCD format	R/W
1081	Year (0…99)	BCD format	R/W
1082	Month (1…12)	BCD format	R/W
1083	Day (1…31)	BCD format	R/W
1084	Weekday (1…7)	BCD format	R/W
1085	Hour (00…23)	BCD format	R/W
1086	Minute (00…59)	BCD format	R/W
1087	Second (00…59)	BCD format	R/W

Special controller flags

2022	No-reply-mode: No-reply-mode allows connecting one operation terminal to multiple controllers. One controller must be in normal operation mode and all the others must be set to no-reply-mode. These controllers will follow each command issued by the operation terminal. They will not send responses and their alarm conditions are not monitored by the operation terminal. 0 = **normal operation**, 1 = no-reply-mode	1bit	R/W
2023	Wink function: activates LED on top of controller 0 = **LED has normal operation**, 1 = LED is constantly on	1bit	R/W
2024	Operation state Summer – Winter (used to switch set point limits for 4-pipe systems) 0 = **Summer mode** 1 = Winter mode	1bit	R/W

Inputs

Address	Input	Description	Range	R/W
1100	UI1	universal input 1 state, 0 = not active / error, 1 = ok	Bit	R
1101	UI1	Unit of universal input 0 = no unit 1 = % 2 = °C /°F 3 = Pa	8bit	R
1102	UI1	Value Multiplier: "**1**" means a multiplication factor of **0.1** "10" means a multiplication factor of 1 "100" means a multiplication factor of 10	8bit	R
1103	UI1	Value	16bit	R
1104	UI2	universal input 2 state, 0 = not active / error, 1 = ok	Bit	R
1105	UI2	Unit of universal input (explanation as in 1101)	8bit	R
1106	UI2	Value Multiplier (explanation as in 1102)	8bit	R
1107	UI2	Value	16bit	R
1108	UI3	universal input 3 state, 0 = not active / error, 1 = ok	Bit	R
1109	UI3	Unit of universal input (explanation as in 1101)	8bit	R
1110	UI3	Value Multiplier (explanation as in 1102)	8bit	R
1111	UI3	Value	16bit	R
1112	UI4	universal input 4 state, 0 = not active / error, 1 = ok	Bit	R
1113	UI4	Unit of universal input (explanation as in 1101)	8bit	R
1114	UI4	Value Multiplier (explanation as in 1102)	8bit	R
1115	UI4	Value	16bit	R
1116	VI1	universal input 7 state, 0 = not active / error, 1 = ok	Bit	R
1117	VI1	Unit of universal input (explanation as in 1101)	8bit	R
1118	VI1	Value Multiplier (explanation as in 1102)	8bit	R
1119	VI1	Value	16bit	R/W
1120	VI2	universal input 8 state, 0 = not active / error, 1 = ok	Bit	R
1121	VI2	Unit of universal input (explanation as in 1101)	8bit	R
1122	VI2	Value Multiplier (explanation as in 1102)	8bit	R
1123	VI2	Value	16bit	R/W
1124	VI3	universal input 9 state, 0 = not active / error, 1 = ok	Bit	R
1125	VI3	Unit of universal input (explanation as in 1101)	8bit	R
1126	VI3	Value Multiplier (explanation as in 1102)	8bit	R
1127	VI3	Value	16bit	R/W
1128	VI4	universal input 10 state, 0 = not active / error, 1 = ok	Bit	R
1129	VI4	Unit of universal input (explanation as in 1101)	8bit	R
1130	VI4	Value Multiplier (explanation as in 1102)	8bit	R
1131	VI4	Value	16bit	R/W

Virtual inputs:

- ➔ The TCX2 can operate with external inputs. To activate, program the virtual input to use it as external input of the communication module: for example 9u00 = 2 (Address 3800 = 2) or 10u00 = 2 (Address 3900 = 2), see static address list on page 8).
- ➔ Then program the master to write to the input address the value to the corresponding input. For example Address 1135 for virtual input 3 and 1139 for virtual input 4. Observe the specified time out limitations in the virtual input settings of the TCX2. If the input is not re-written within the time out limits, the TCX2 will disable the corresponding virtual input and with it all associated control functions.

Control loop

Address	Loop	Description	Range	R/W
1200	Loop 1	Control input state	8Bit	R
1201	Loop 1	Control loop sequence 1 = heating, 0 = cooling	1bit	R
1202	Loop 1	Control input unit	8 bit	R
1203	Loop 1	Control input value	16bit	R
1204	Loop 1	Saved Setpoint	8Bit	R/W
1205	Loop 1	Calculated Setpoint	8Bit	R
1206	Loop 1	Proportional output	8bit	R
1207	Loop 1	Binary output	8Bit	R

Digital Outputs

Address	DO	Description	Range	R/W
1400	DO1	State Bit 0: 0= Floating mode is OFF, 1 = Floating mode is ON Bit 1: 0= not active / error, 1 = active and ok Bit 2: 0 = automatic mode, 1 = manual mode Bit 3: 0 = PWM not active, 1 = PWM active Bit 6: 0 = Run time totalizer disabled, 1 = Run time totalizer ON Bit 7: 0 = Run time limit not reached, 1 = Run time limit reached Bit 3 to 7 only apply if Bit 0 = 0 (no 3 point floating output)	8Bit	R
1401	DO1	Current value	8bit	R
1402	DO1	Override value (Only applies if output set to manual)	8bit	R/W
1403	DO2	State, as on 1400	8Bit	R
1404	DO2	Current value	8bit	R
1405	DO2	Override value (Only applies if output set to manual)	8bit	R/W
1406	DO3	State, as on 1400	8Bit	R
1407	DO3	Current value	8bit	R
1408	DO3	Override value (Only applies if output set to manual)	8bit	R/W
1409	DO4	State, as on 1400	8Bit	R
1410	DO4	Current value	8bit	R
1411	DO4	Override value (Only applies if output set to manual)	8bit	R/W
1412	DO5	State, as on 1400	8Bit	R
1413	DO5	Current value	8bit	R
1414	DO5	Override value (Only applies if output set to manual)	8bit	R/W

Fans

1500	FAN1	State Bit 0/1:= Current fan output Bit 2: 0= not active / error, 1 = active and ok Bit 3: automatic mode, 1 = manual mode Bit4/5: = Total number of fan speeds Bit 6: 0 = Fan mode active, 1 = rotation mode is active Bit 7: 0 = Manual fan off disabled, 1 = Manual fan off enabled	8Bit	R
1501	FAN1	Current value	1Bit	R
1502	FAN1	Override value	16bit	R/W

Alarms

1600	ALA1	Alarm active 0 = not active, 1 = active	1Bit	R
1601	ALA1	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1602	ALA2	Alarm active 0 = not active, 1 = active	1Bit	R
1603	ALA2	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1604	ALA3	Alarm active 0 = not active, 1 = active	1Bit	R
1605	ALA3	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1606	ALA4	Alarm active 0 = not active, 1 = active	1Bit	R
1607	ALA4	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1608	ALA5	Alarm active 0 = not active, 1 = active	1Bit	R
1609	ALA5	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1610	ALA6	Alarm active 0 = not active, 1 = active	1Bit	R
1611	ALA6	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1612	ALA7	Alarm active 0 = not active, 1 = active	1Bit	R
1613	ALA7	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1614	ALA8	Alarm active 0 = not active, 1 = active	1Bit	R
1615	ALA8	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*

*) Writable to 0 = confirmed only if state is 1 = not confirmed;

Static Modbus Address List

With these addresses the settings may be changed of the controller. They correspond with the parameter settings for the addressed TCX2 controller. The address is calculated by the parameter number of the controller, the number of the function minus 1 and then multiplied with 100 and the table below. For example the address for parameters for universal input 3 starts at address: (3-1) x 100 + 3000 = 3200.

Description	1	2	3	4	5	6	7	8	9	10	11	12
User settings	2000											
Universal input	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900		
Control Loop	5000											
Binary Output	7000	7100	7200	7300								
Fan output	8000											
Alarm	9000	9100	9200	9300	9400	9500	9600	9700				
Functions	10000	10100	10200	10300	10400							
Time Schedules	11100	11200	11300	11400	11500	11600	11700	11800	11900	12000	12100	12200
Communication	13000											

Time schedule Settings

Time schedules are slightly special as they do not operate with parameters. Time Schedules addresses start at address 11000. To remotely change time schedule settings, follow the table below.

Address	Module	Description	Range	R/W
11000	General	Enable time schedules	1bit	R/W
Table+0	SCHED1	Time of time schedule event	time	R/W
Table+1	SCHED1	Active days of time schedule event (bits) Bit 0 = Day 1 (Monday) Bit 1 = Day 2 (Tuesday) Bit 2 = Day 3 (Wednesday) Bit 3 = Day 4 (Thursday) Bit 4 = Day 5 (Friday) Bit 5 = Day 6 (Saturday) Bit 6 = Day 7 (Sunday)	8bit	R/W
Table+2	SCHED1	Type of time schedule: 0 = Disabled 1 = Operation mode 2 = Control loop setpoint 3 = Analog output setpoint 4 = Fan output 5 = Binary output	8bit	R/W
Table+3	SCHED1	ID of time schedule: Will show only if type of schedule is not operation mode.	8bit	R/W
Table+4	SCHED1	Set point of time schedule: If type of times schedule is operation mode (Table+2=1): 0 = OFF, 1 = Economy, 2 = ON For all other types: The value represents the set point	8bit	R/W