

MOUSE MEDIA

VELBUS HOME AUTOMATION SYSTEMS

HEATING AND COOLING

INTEGRATION GUIDE

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2. INTRODUCTION

Velbus is a modular system where every module has its own processor and memory connected by a “bus” system. This means you do not need to install a central control unit and prevents the entire home automation system from being blocked by a central unit failure. As the Velbus system does not require any master controller and relies on the backend bus every module can be placed anywhere in the house. This is especially useful when integrating heating and cooling units, so that the control of those units can be placed locally at the IO boards of the heating/cooling equipment. Every module in the range has its own unique characteristics in the system, from switching relays to variable power outputs, etc.

The bus system is based on the extremely stable and reliable CAN bus used in the automotive sector. The most basic set-up has two modules: an input module and an output module. An input module uses short messages to send its status to the bus. An output module interprets these messages and executes actions relating to its programming

Velbus can easily be configured to command HVAC systems and this document describes the cabling options as well as some configuration examples for integration. While each system has its own unique characteristics and connection options, this document provides high-level integration options only.

3. INPUT PANELS AS THERMOSTATS

Within the Velbus system, each wall input module acts as a full thermostat. Every thermostat has several "channels" that can trigger actions.



Figure 1: VMBELO series in thermostat mode

Each thermostat is a logic unit that can be controlled from any module if configured. This means that on a single panel, you can control multiple rooms by switching to the right thermostat name.

Once on the right thermostat control page, the user can configure multiple items. Firstly, the desired temperature can be configured using the + and – buttons (right and bottom). By default, the "mode" temperature is loaded. Temporary adjustments can also be made. By clicking the top button of the panel, it can be activated for x hours or permanent (deviating from the preset mode). This is useful when a temporary change of temperature is desired. It is also possible to switch back to the preset value by clicking until the icons disappear.

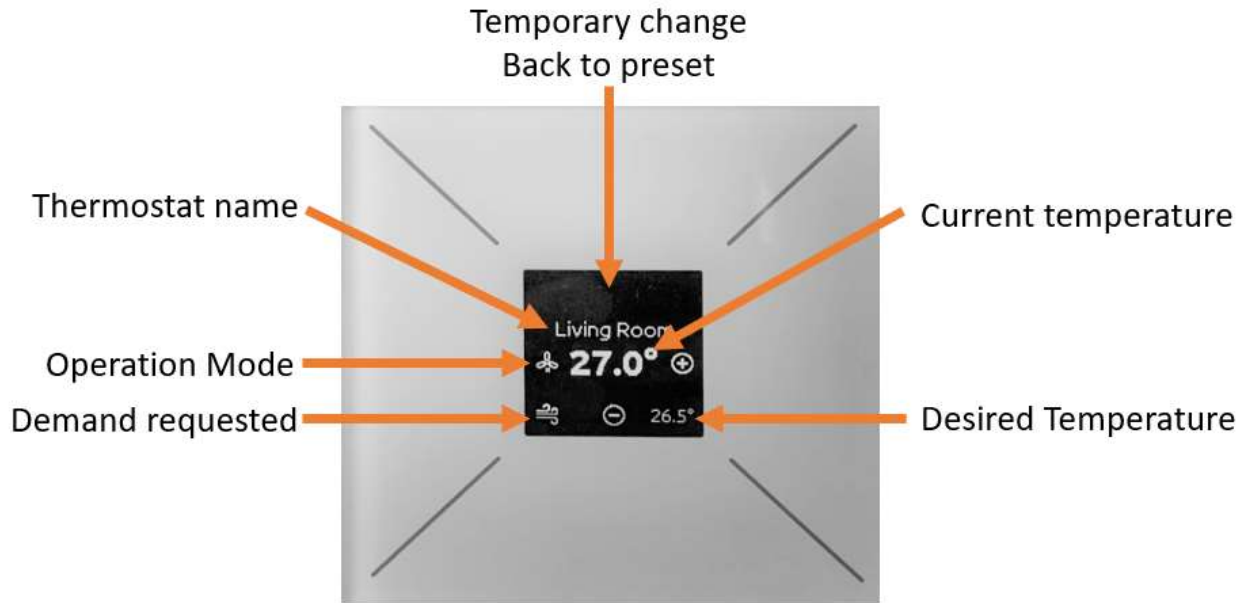


Figure 2: VMBELO thermostat display

Every thermostat has an operational mode. This is switched by the left touchpad and the current operational mode is displayed in the window. It's either an x, I, II, or III beneath the fan icon. A blower on the left bottom will indicate the cooling channel is activated (similar for heating indicated by sun/moon/freeze icons).

Note that more information on the inputs and controlling the VMBELO thermostat is available in the Velbus documentation. A short reference sheet has been added in the appendix of this document.

Ultimately, each input module with the thermostat activated provides several channels. These channels are made visible in the software and can be used to configure actions – driving other Velbus modules to switch, increase/decrease power, etc.

VMBGPOD-2	02,06
Push button 1	CH1
Push button 2	CH2
Push button 3	CH3
Push button 4	CH4
Push button 5	CH5
Push button 6	CH6
Push button 7	CH7
Push button 8	CH8
Temp. sensor	CH34
Heater	CH35
Boost	CH36
Pump	CH37
Cooler	CH38
Alarm 1	CH39
Alarm 2	CH40
Alarm 3	CH41
Alarm 4	CH42

Figure 3 Overview of channels available per input panel

The following channels are available:

1. Temp. sensor
 - (providing current temperature value only)
2. Heater
 - Enabled when thermostat is in heating mode and current temperature + delta < desired temperature
3. Boost
 - Enabled when thermostat is current temperature + delta >/< desired temperature +/- booster setting temperature (for example +3 degrees or – 3 degrees difference)
4. Pump
 - triggers at the same time as the Heater channel with programmable offset times. Can also be used to run an service cycle during warmer months to ensure the pump runs daily.
5. Chiller
 - Enabled when thermostat is in cooling mode and current temperature + delta > desired temperature
 -
6. Alarm 1

- Can raise alarms when temperature is out of bound / by external input
- Can be used as pre-set temperature and operation mode for STANDBY-FROST PROTECTION/DAY/NIGHT/COMFORT
- Can be set uniquely or shared with other alarms

7. Alarm 2

- Can raise alarms when temperature is out of bound / by external input
- Can be used as pre-set temperature and operation mode for STANDBY-FROST PROTECTION/DAY/NIGHT/COMFORT
- Can be set uniquely or shared with other alarms

8. Alarm 3

- Can raise alarms when temperature is out of bound / by external input
- Can be used as pre-set temperature and operation mode for STANDBY-FROST PROTECTION/DAY/NIGHT/COMFORT
- Can be set uniquely or shared with other alarms

9. Alarm 4

- Can raise alarms when temperature is out of bound / by external input
- Can be used as pre-set temperature and operation mode for STANDBY-FROST PROTECTION/DAY/NIGHT/COMFORT
- Can be set uniquely or shared with other alarms

For example: a sensor on a door can force an alarm to set the thermostat in safe mode, or the alarm (safe mode) can be activated from the thermostat panel or raised by reaching a certain temperature.

i. Thermostat options

While the detailed manual is available in the Velbus documentation, this document focuses on the connections and configuration of the heating/cooling system and how these channels / options can be used.

The presets window for each of the thermostats allows the system administrator to configure default temperature values for each preset. This is useful when configuring day/night/away temperature preferences and using an automated schedule to switch between them.

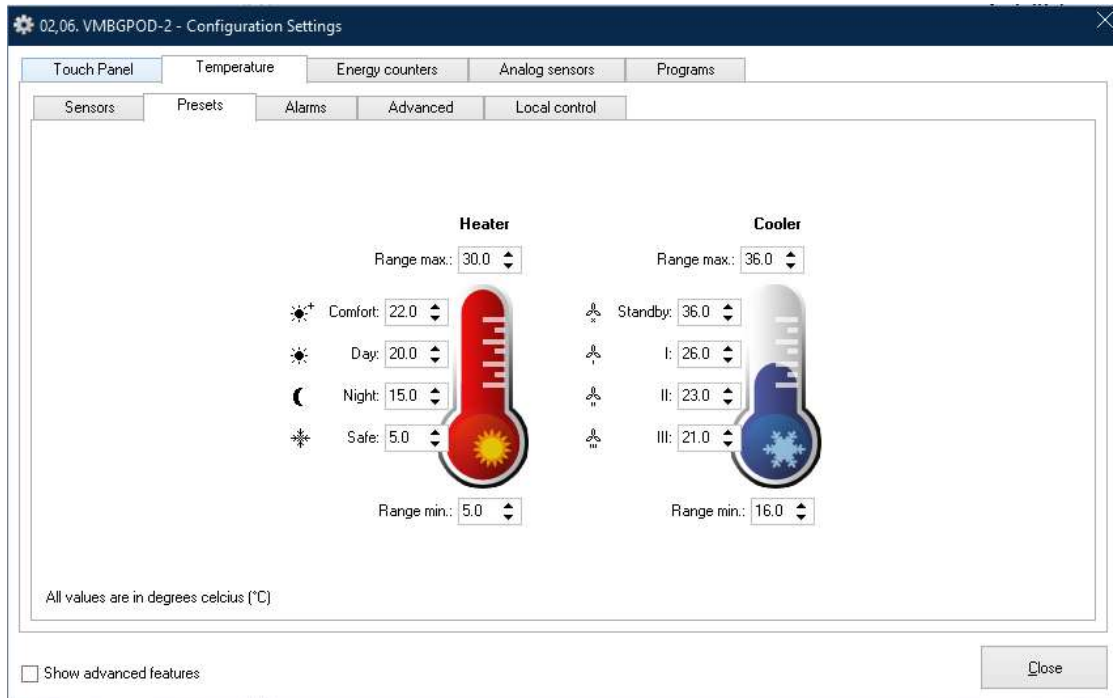


Figure 4: Configuring preset temperatures for modes

These presets however can also be used to control an HVAC in other ways, by linking them to the alarm channels as discussed in the next chapter.

For example, these presents can be used in combination with an AC system to provide the following modes:

- standby is off – with a maximum temperature of 30C.
- mode I enables fan jointly with the compressor.
- mode II is continuous fan in low setting while the compressor switches on and off as demand is requested.
- mode III is fan in high setting while the compressor switches on and off as demand is requested.

The range max and range min on the presets page are used to set the upper and lower limit on the thermostat (meaning you can drop the requested temperature to only the configured minimum and maximum).

Note that if the actual temperature is outside the maximum and minimum value but a trigger has not been sent (power restore for example), a trigger is not sent to the actuators and a manual override of the heating/cooling system will be required – which can be done by switching the heating/cooling mode on a panel or via the Velbus Link software.

Each thermostat can be set in either cooling mode or heating mode. Ensuring that only the heater channel or cooling channel can be used. Switching between the two modes can be done through the software, by a switch or programmatically based on room temperature or calendar.

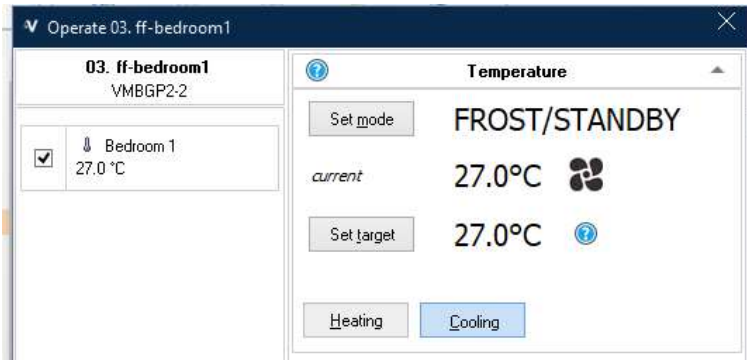


Figure 5: Mode, Target and Heating or Cooling settings in VelbusLink

In the advanced section of the Velbus Link software, it is also possible to configure additional settings, such as

- **Hysteresis**, the temperature deviation allowed before activating the heating/cooling channel
- **Boost heater diff**, the offset temperature before activating the boost channel
- **Minimum switching time**, safeguard time to avoid “flipping” of the channels. Each channel needs to be activated for at least xx seconds
- **Calibration offset**, the difference between the actual temperature and measured temperature by the module
- **Safeguards**: can use used to enable the pump and heater channel to activate daily to avoid jamming of these components.
- **Temporary mode**: can be used to set a default time for temporary demand temperature changes – if set to 0, the display panel will not show any icon, but pressing the top button will revert the thermostat to the default temperature for the active mode.

Adjustments

Hysteresis: °C

Boost heater diff.: °C

Min. switching time: sec.

Calibration offset: °C

Pump

Pump on delay: sec.

Pump off delay: sec.

Safeguards

Activate temperature channels to avoid jamming
(1x a day for 1 minute)

Enable for heater channel

Enable for pump channel

Temporary mode

Days: Hours: Minutes:

Auto-send of the temperature

Connect to the bus to display the status ?

Figure 6: Advanced settings for a thermostat

ii. Alarms

The alarm channels (1-4) can be used in multiple ways. They can be activated by external input, by pre-configured temperature settings or thermostat operational modes. Each alarm channel can drive one or more output modules. Alarm channels can be uniquely activated (only 1 alarm active at a time) or can be run in parallel mode (multiple alarms can be active at a time).

Each thermostat has 4 operational modes (for heating/cooling setting). These are:

- Standby / frost protection
- Comfort I
- Night II
- Day III

Each of these can be individually linked to the alarms available and can have preset desired temperatures. For example, it is possible to run a schedule that switches the alarms between day and night and have the desired temperature switch accordingly (for example 18C during the evening and 22C during the day), or when on vacation/away have only frost protection on.

In “Temperature above” mode – an alarm can be activated if the measured temperature is above the setting (or above current target + offset) – to for example start additional cooling/heating capacity. This is useful when a heating or cooling system has various performance levels of operation and is in default mode not

capable of cooling down or heating the room. Another option could also be to alert someone – for example that a door is left open, extreme heat is detected or freezing levels are being reached.

They can also be used to configure actions on the “modes” that are available such as day/night/standby.

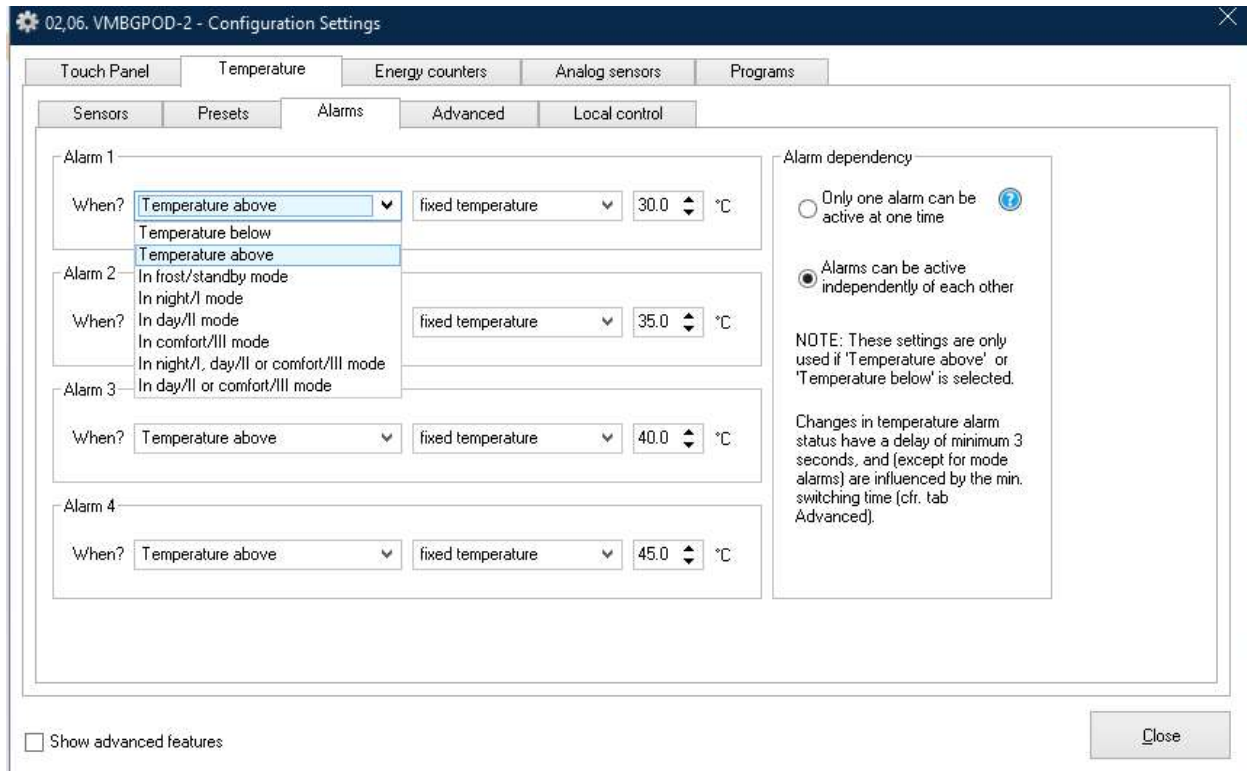


Figure 7: Configuring alarms to be used as modes

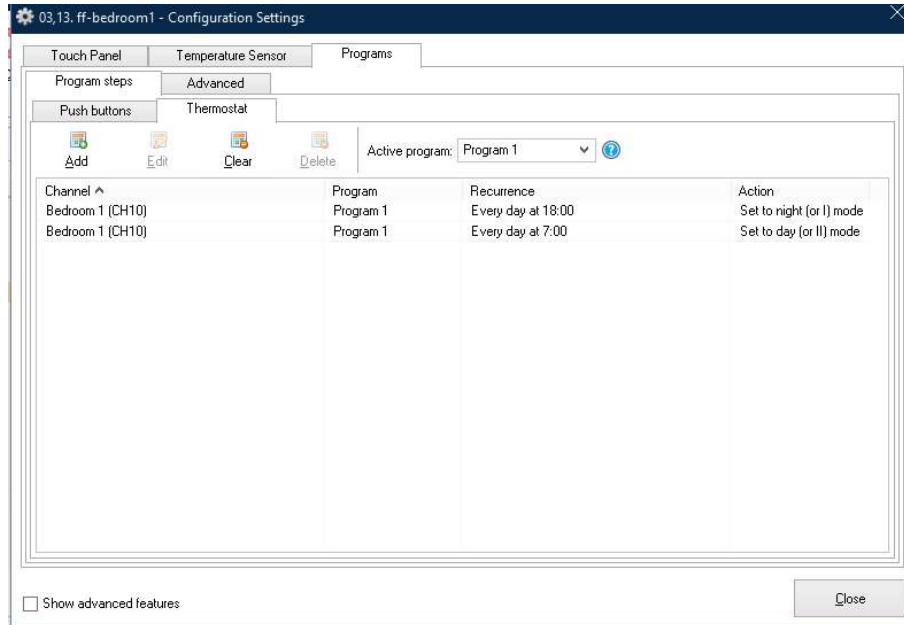
When configured as frost/night/day/comfort mode, these alarms (and thus actions related to them) can be activated directly from the thermostat by switching the mode on the panel.

iii. Running programs

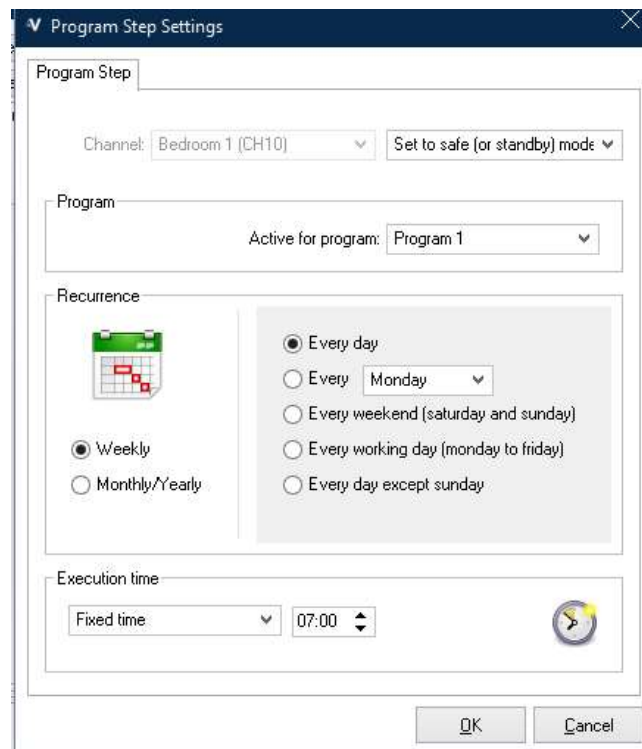
Automation wouldn't be automation without programs that set the lights, temperatures and manage items fully for you. Within Velbus automation is managed by the input modules, and for the heating/cooling systems especially, the automation programs are embedded in the control panels. In order to setup automation, the glass panel needs to be configured as a thermostat. Without a thermostat active, the temperature programs will not be available.

The automation starts with the predefined temperatures in the thermostat. In there is day, night, comfort and stand-by for heating while (fan) mode I, II, III and IV are available in cooling mode.

Switching between these programs can be configured under programs – thermostat. There are by default 3 programs that can be activated. So that you can have a program for if you are on holiday, always home and a spare program. Each program can contain multiple rules.

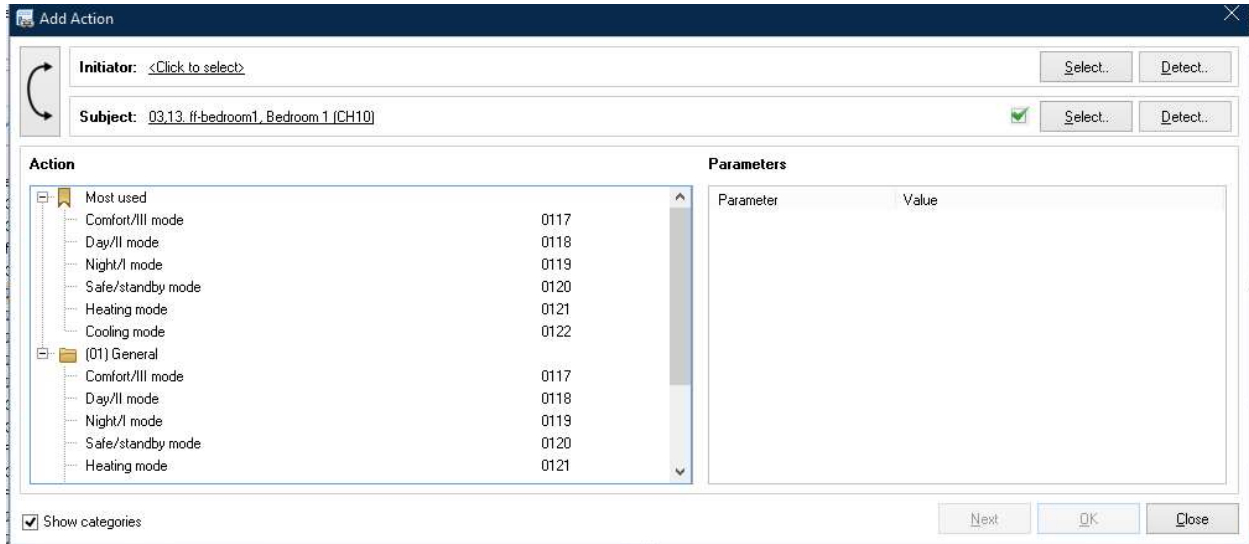


Each rule has a trigger, which is usually based on a day/time input and an action – which is activating a specific mode. And each rule needs to be linked to a program.

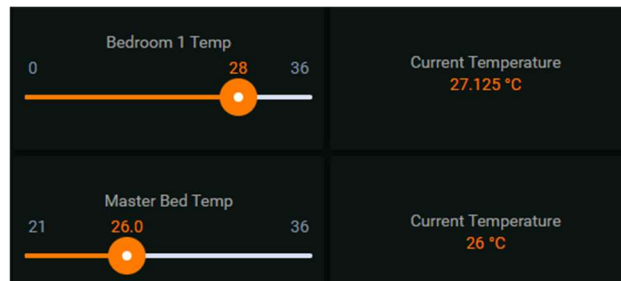


The timing can be based on fixed times, sunrise, and sunset rules (to make it a bit more dynamic) and can reoccur every day, weekdays etc.

It is also possible to have a relay/or other input channel action the thermostat directly. By creating a new action and pointing to the thermostat channel as the subject you can switch directly to a preset mode:



Note that by default, Velbus does not allow you to directly set a “setpoint” temperature as an action. But additional control of the thermostat can be achieved using external compute modules, such as OpenHab/HomeServer as these allow direct input and setting the setpoint temperature. Which also provides additional options for automation and a more granular temperature control with various inputs.



4. CONNECTION OPTIONS / MODULES

Velbus provides various connection methods to external systems, these include input as well as outputs. Configuration of these outputs is done with the Velbus Link software. In this software logic between various inputs (such as temperature, wind speeds, motion sensors, static values, etc) can be linked to the various output channels with “actions”. Actions include on/off, follow, delayed on/off and many more. More information on the actual modules that can provide these IO options can be found on https://www.velbus.eu/downloads/velbus/00_general/guide_velbus_actions_descriptions_en.html

The various output logic that can be provided by Velbus modules:

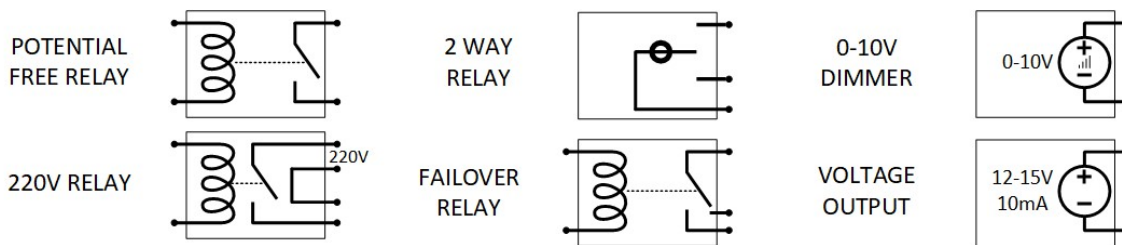


Figure 8: Output logic options

For input, Velbus has its own panels (for thermostats, push buttons, wind direction and speed, motion switches etc) as well as external input switches. These can be either packed in single units, or multiple input channels combined.

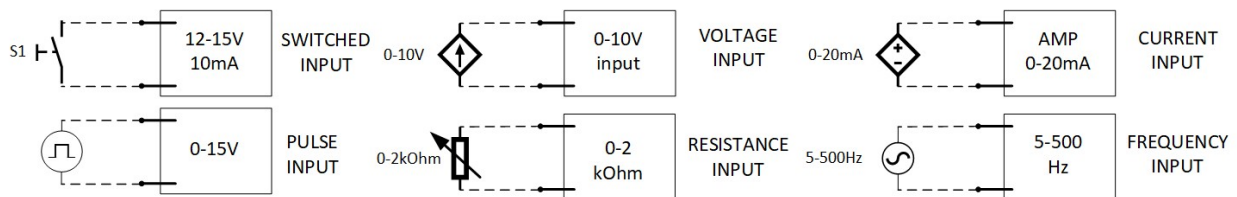


Figure 9: Input logic options

It is however also possible to link the Velbus system to a central home server to further enhance the capabilities, including but not limited to: Zigbee, Ikea Tradferi, KNX, BACnet, etc. This can be done through OpenHab, Home Automation or any other application that supports Velbus connectivity.

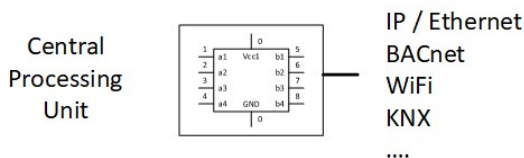


Figure 10: Computer processing options

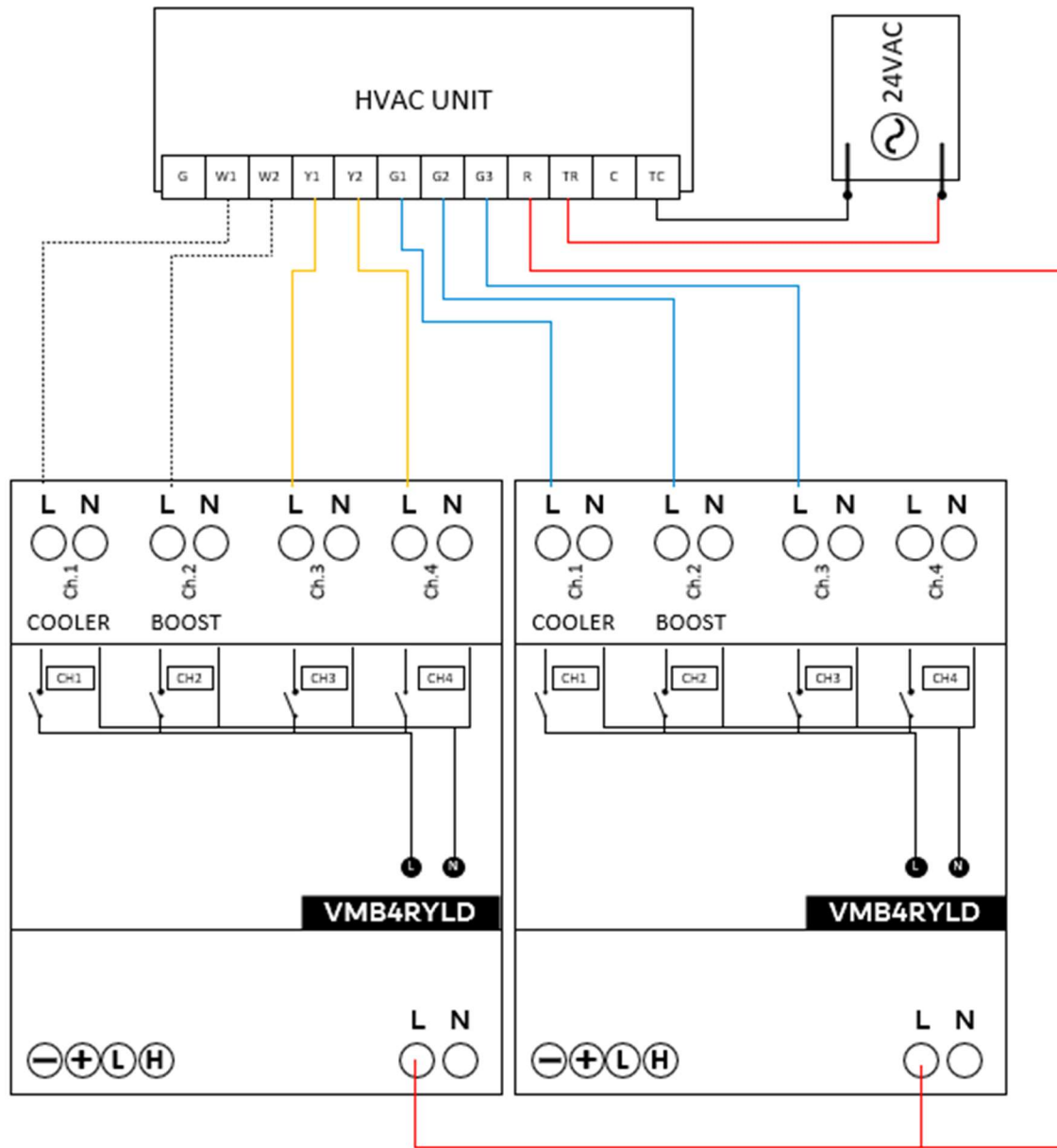
Velbus provides the Signum IoT interface for this. More information on the supported protocols in the Signum can be found on the Velbus website. The connection into a software application also provides the ability to run extensive scripts and rules and configure the system and logic to any desired method. In many cases a simple Raspberry PI, Odroid C4 or other system will suffice with a choice of open source software. Integration with commercial platforms such as Control4 & Trigger is available today as well, while Crestron, Elan and URC-Automation will follow soon.

5. STANDARD HEATER / AC CONNECTIONS

Each HVAC unit usually exposes the various controls to a “regular” thermostat interface. Within most systems the heating is identified as W, cooling is the Y connection and G is for the fan. Many advanced units also allow for multiple inputs to drive the units:

- W/W1 – initial Heater demand connection
- W2 – boosted heater connection
- Y/Y1 – initial cooling connection
- Y2 – booster cooling connection
- G – auto fan speed
- G1 – low fan speed
- G2 – medium fan speed
- G3 – high fan speed

Many control boards and thermostats work on 24V AC – and thus the controller/converter and the thermostat require 24Volts to work. Very old thermostats do not require the Common (ground) connection – as switching is done through the R connection. If you have a controller that requires external power input the TR and TC are to be connected to the external power source, the R and C are for powering the thermostat. In order to activate a demand channel, the R input on the thermostat is shorted with the desired output (W/Y/G) connections.



The image above showcases a full connection to an extended HVAC unit using 2 VMB4RYLD's, utilizing 7 channels total. The RYLD's switch the 24V AC (R) coming from the HVAC unit to enable/disable each of the demand inputs (W/Y/G). Note that the RYLD does not require any common (C) connection as it uses the Velbus bus power for switching.

For more advanced units, an external thermostat interface might be required – usually an optional accessory.

Other HVAC units might have dedicated connections on their controller boards (PCB's) which allow direct interaction with Velbus input and output modules.

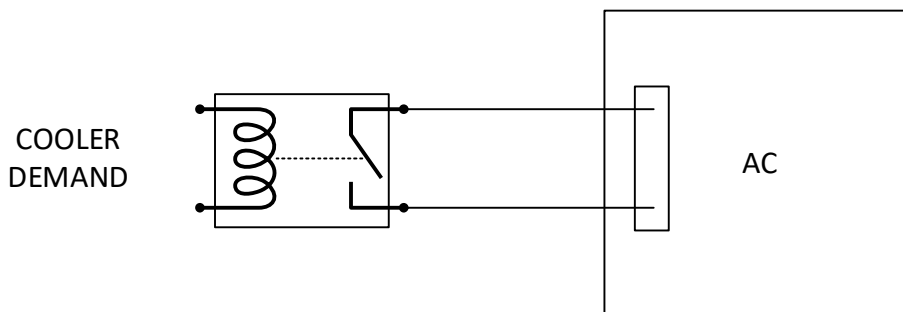
6. HEATER / AC CONNECTION EXAMPLES

This chapter provides hints on how to connect the various output modules to HVAC systems. In many cases the HVAC IO board includes the ability to attach external relays to set certain functions. Or in some cases, the IO board also provides output feedback for receiving status and error information. These can be linked to the Velbus input modules for further actions within the system (such as lighting a panel red if an error occurs).

i. Minimal Cooler/Heater demand example

In regular (minimal) configuration for a heater/ac, the heater and chiller channels can be linked to a potential free relay acting as a 'regular external' input thermostat to the heating/air conditioning units. The relays can open/close when demand is requested. The thermostat will also be in 1 mode only (cooling or heating), and thus, the cooling channel and heating channel cannot be activated simultaneously.

Figure 11: Simple AC demand connection



This can for example be used to link the Velbus system to a Mitsubishi AC IO board (PAC-SF40RM-E) – a snippet of the installation documentation is shown below. In this case the relay output of Velbus would be connected to the **TB3** external input.

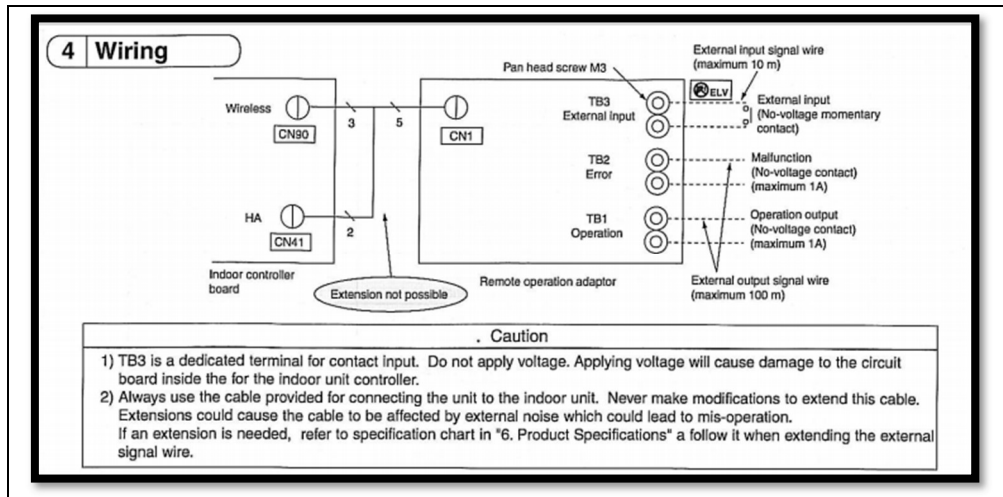
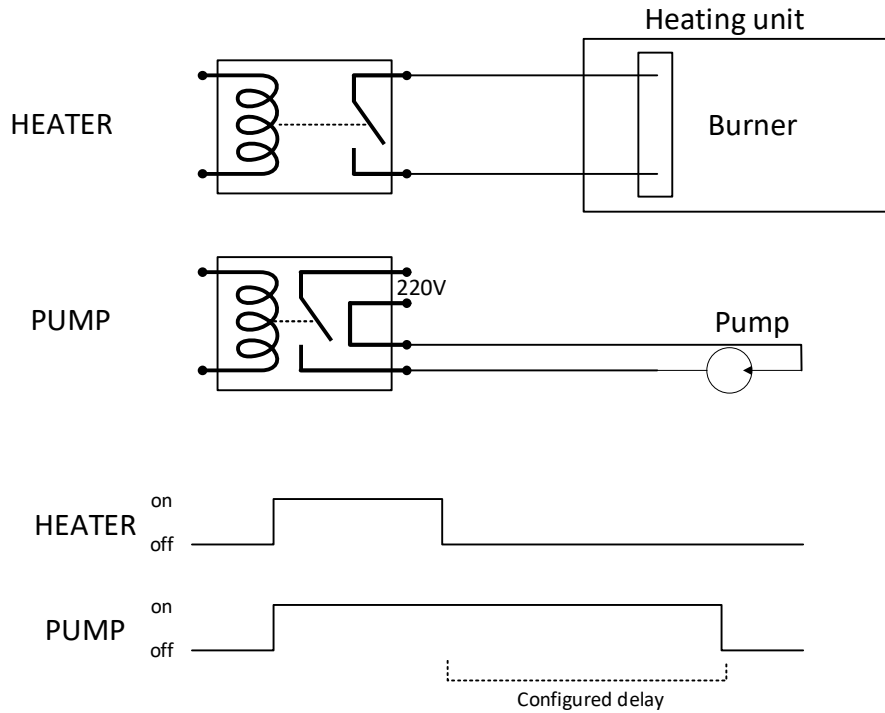


Figure 12: Example of IO board connections from Mitsubishi AC unit manual

ii. Heater with external pump example

The pump channel can also be used separately in heating situations to have separate control over the actual heater (generating heat) and the pump (for distributing heat), this could be an actual pump or actuator that opens/closes. This way, the heater can heat up the water in the system for X minutes, and the pump can continue to distribute the heat for Y number of minutes after the burner has stopped. This pump delay can be configured on the thermostat controlling the heating channel.

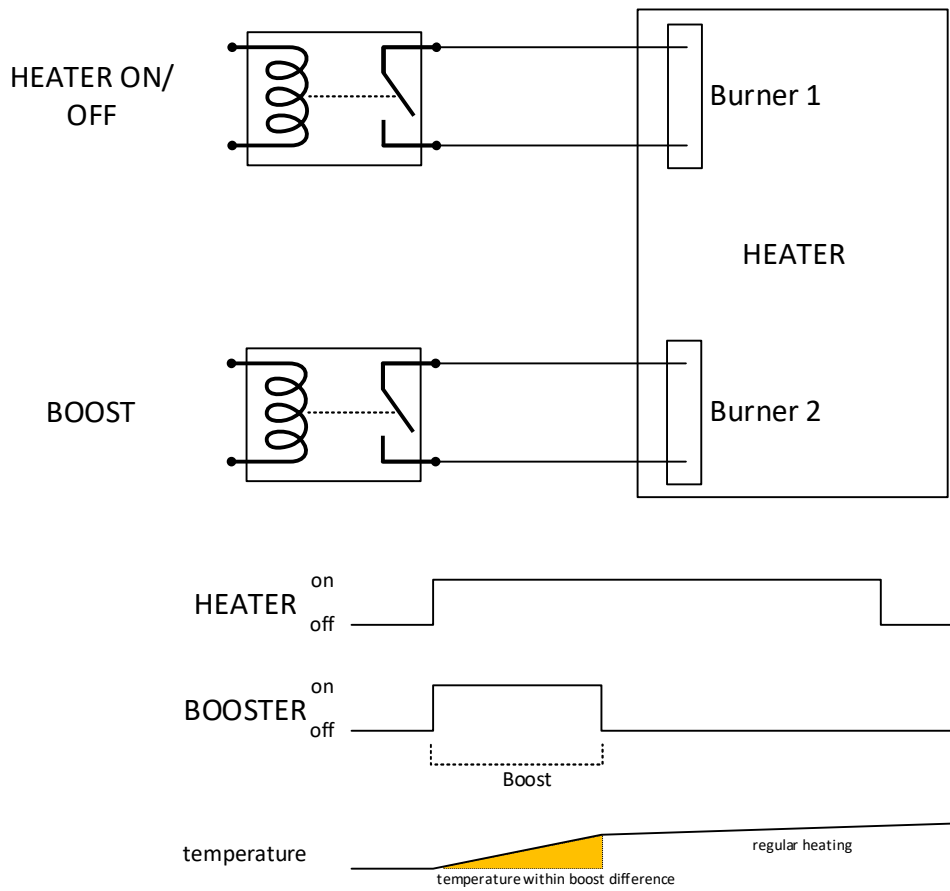
Figure 13: Simple heater connection with separate pump channel



iii. Heater with booster example

Booster channels can be used to instruct the heating unit to perform at full throttle. This could be a fan setting (high-speed fan) or instructing a 2nd burner to initiate to increase the heat faster. For example, the (measured) room temperature could be 18C, while the requested (set) temperature is 28C. If the booster temperature offset is set to 3C, the thermostat will activate the heater & booster channel simultaneously. In the below graphic, the booster channel is linked to a second burner (or equally a second or third heat outlet in the same zone). Once the detected temperature is within the configured offset of the temperature sensor (25C), the booster channel is disabled and regular heating (single burner) is resumed until the desired temperature is reached (28C).

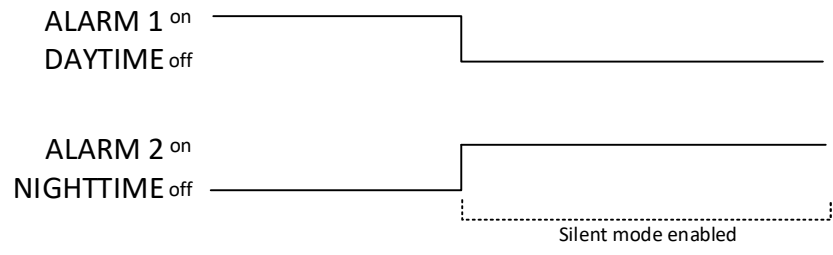
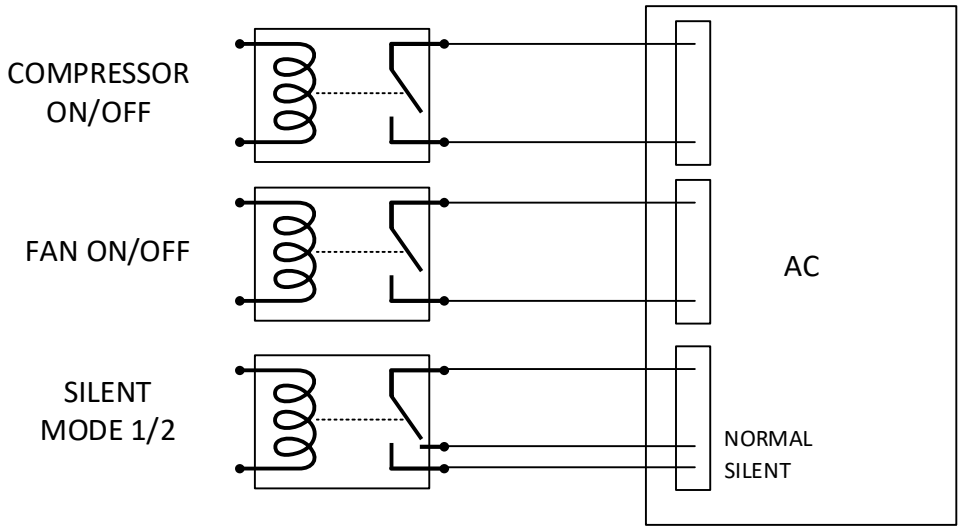
Figure 14: Using booster channel



iv. AC with Alarm channels

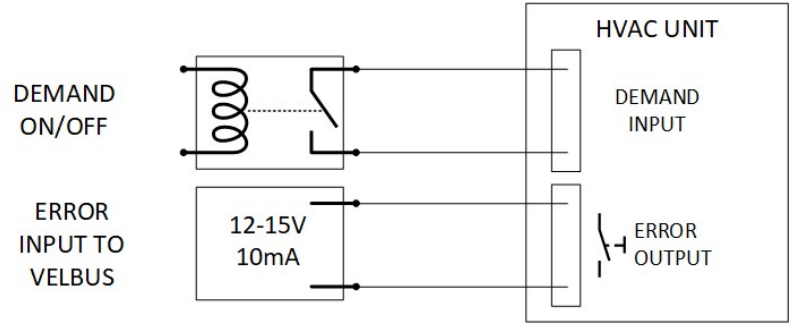
While alarm channels can be used to set predefined temperatures, they can also be used in conjunction with other elements within the system. Some AC's for example provide a silent mode – which reduces the capacity (and noise) of the compressor. This can be useful during the night or when requested by a user.

Figure 15: Using thermostat modes for silent operation

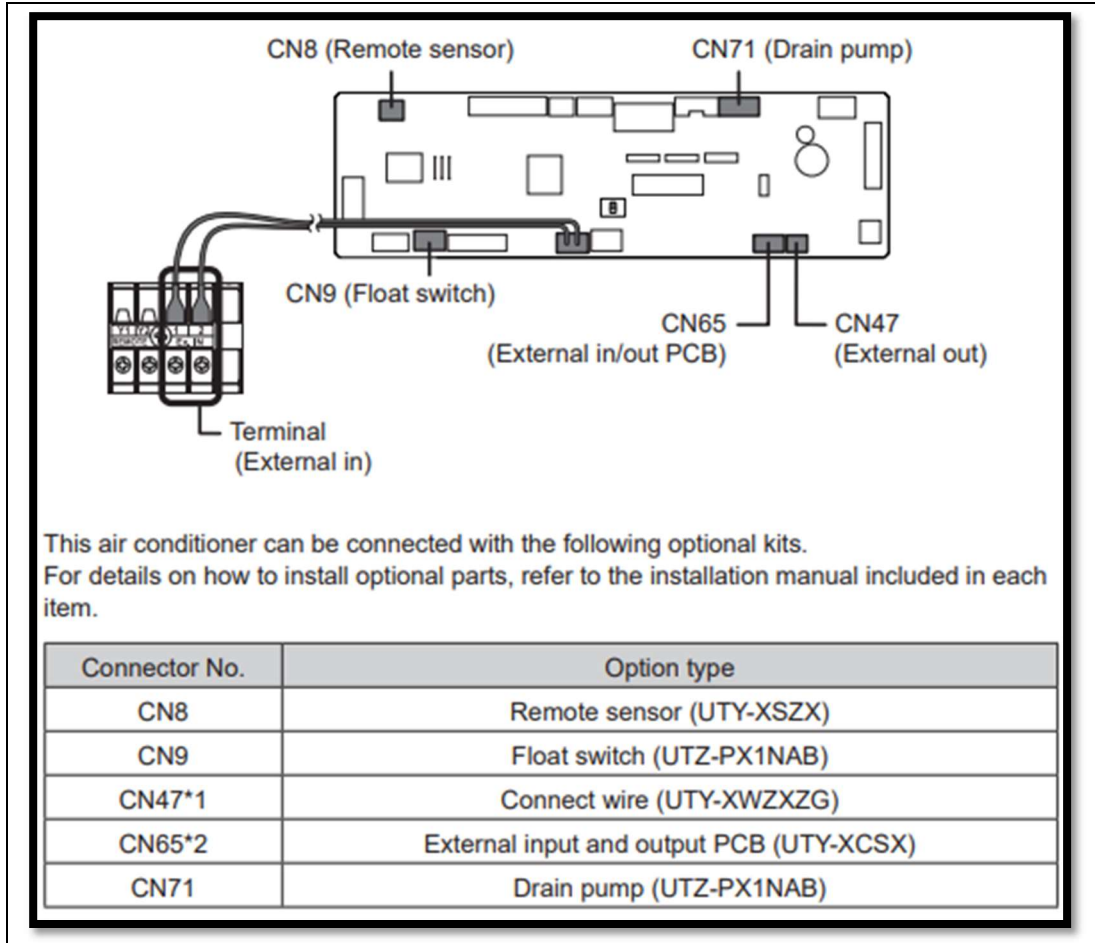


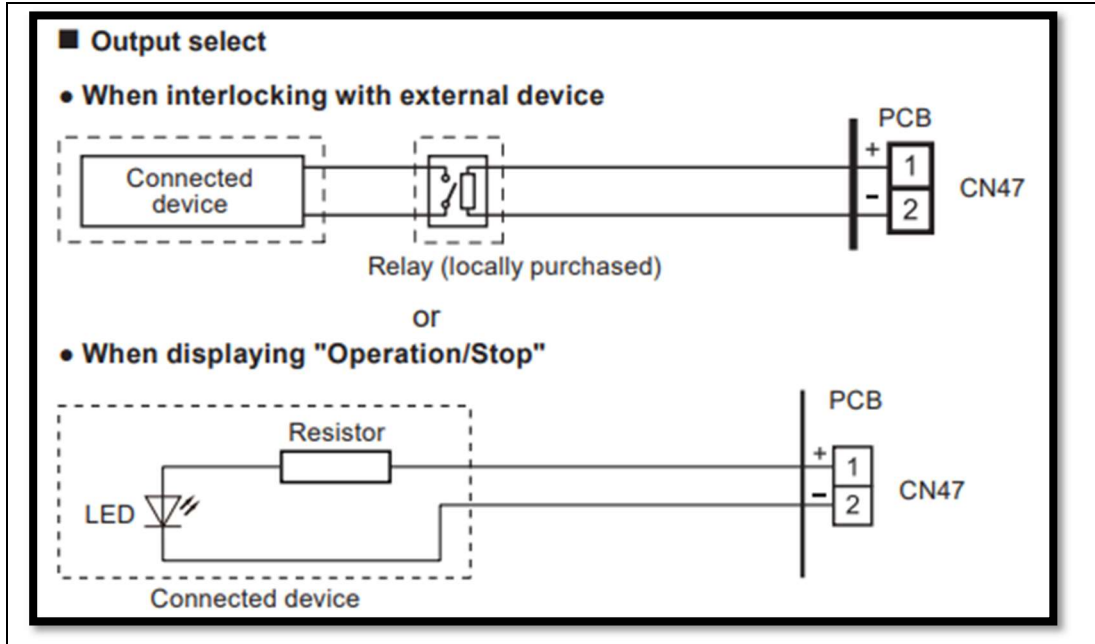
v. HVAC with error return

Output channels from the HVAC unit can also be absorbed by Velbus to configure actions. This can for example be to show red lights around the VMBEL series thermostats indicating a failure, or even fully blocking other channels from activating. With the extension into a centralized computer (Signum/OpenHab/Home Automation) alerts such as email notifications or SMS messages can also be configured.



The below image is a snippet from a Fujitsu Siemens AC unit to provide external connections and showing which accessories might be required to link to external (e.g. Velbus) systems:





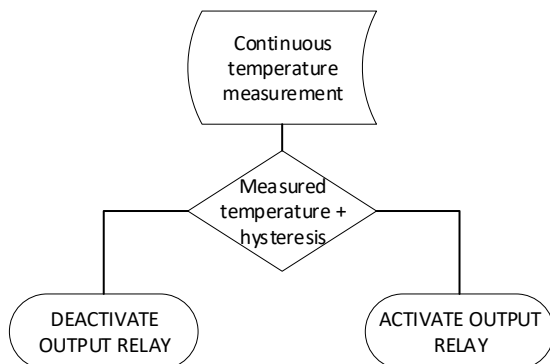
As indicated in the above picture, the output of CN47 will provide power output in case of an error. In this case, the Voltage Input module can also be used with a trigger (action) on a certain voltage, or an external relay can be used in combination with a switch input.

7. VELBUS CONFIGURATION

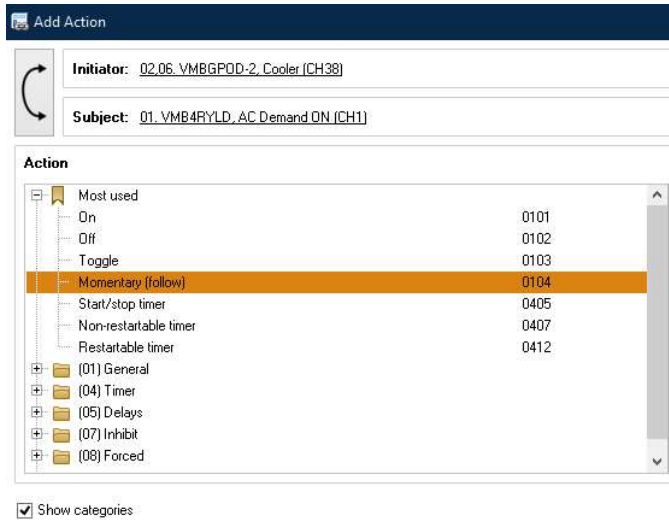
This chapter describes the options for configuring the Velbus automation system for the example as per the connection scenario's above. This is just to provide a quick overview of some of the possibilities. Additional configuration might be required to optimize the systems and integration.

i. Simple demand connection

This is a simple connection for a cooler demand connection.

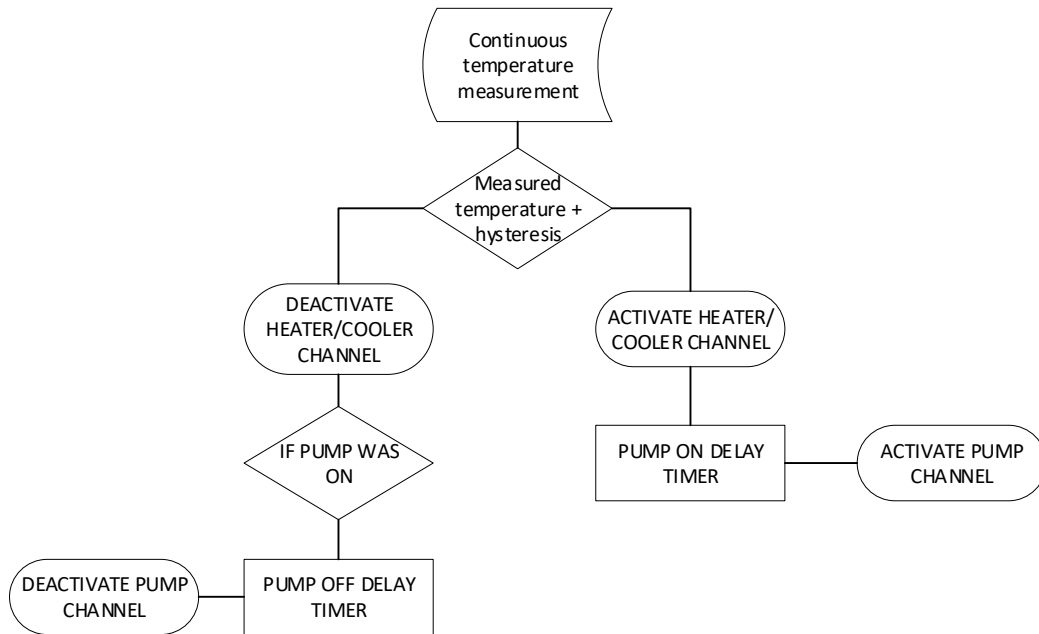


The configuration in Velbus is simple, the Cooler channel of the input panel is linked to the relay channel with the 0104 action “Momentarily” (follow). This mode ensures that as long as the “cooler” channel is activated, the relay is activated as well.

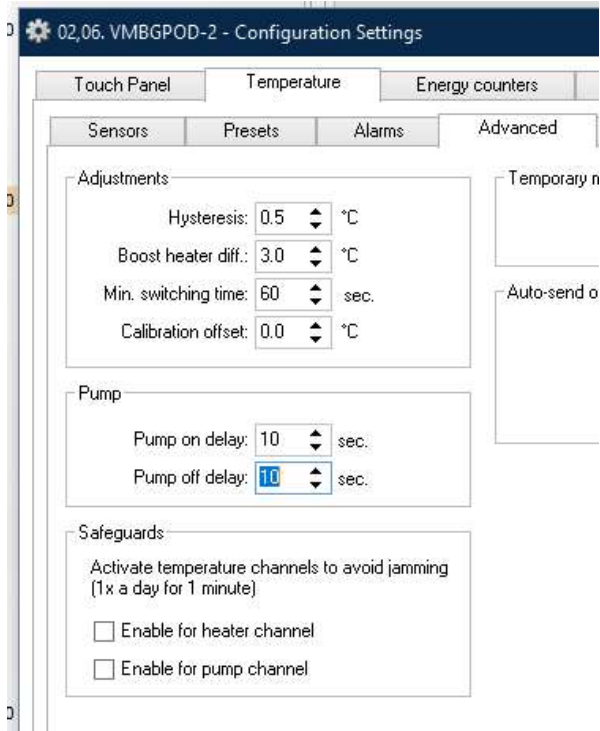


ii. Heater and pump configuration

When connecting a heater unit with a separate pump-channel additional configuration is required.

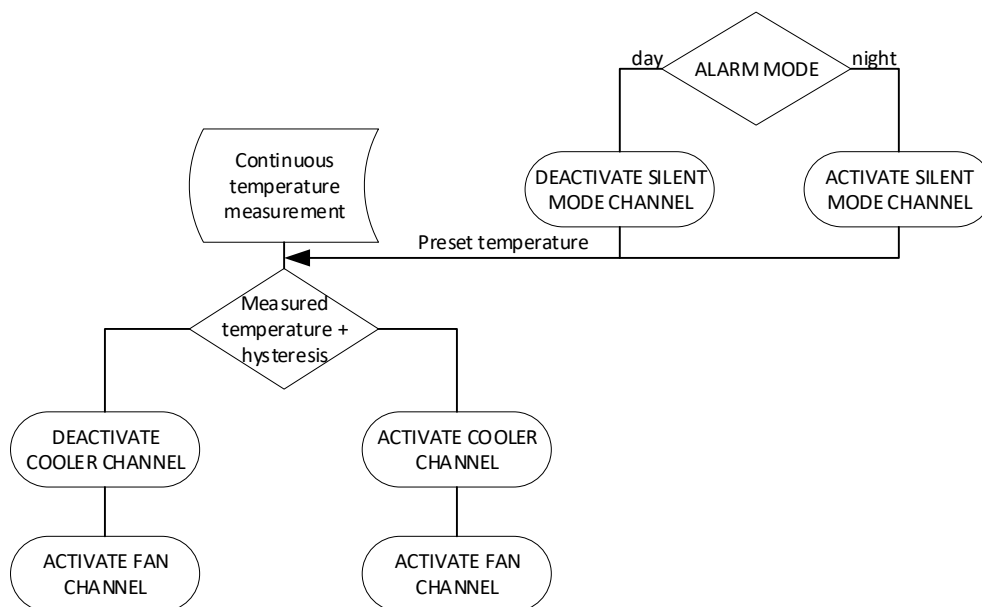


The heater channel can be linked to the relay for heating demand, and the pump relay can be linked to the pump itself (either directly or through a control board). In the software itself, the pump delay (for on as well as off) can be configured.

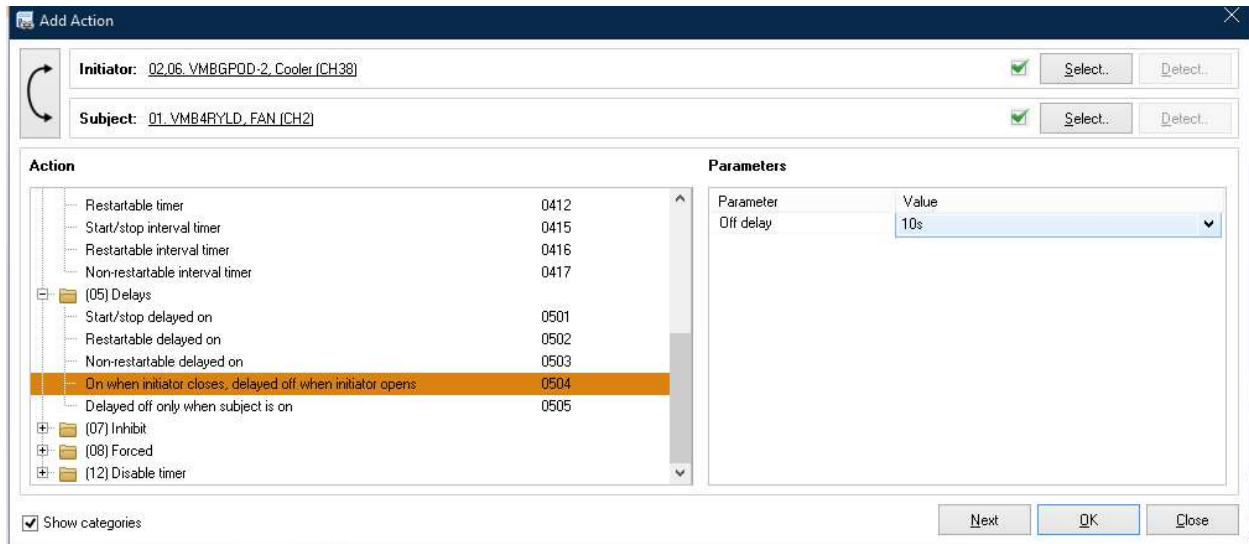


iii. Using alarms for day/night mode

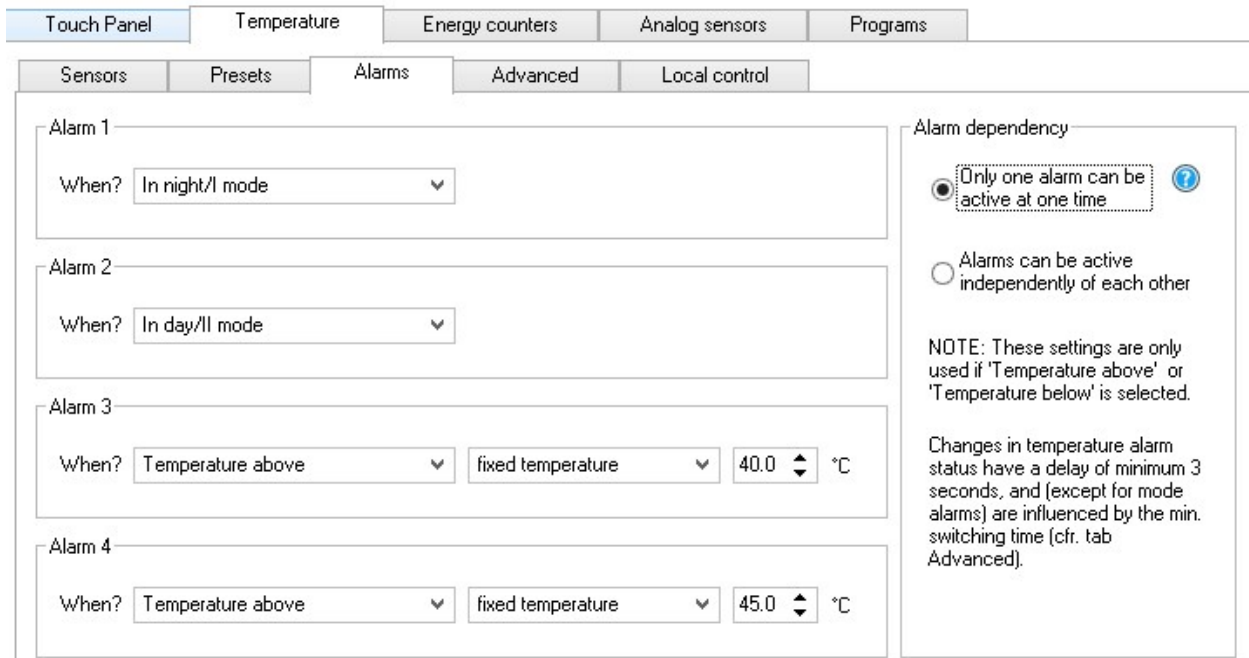
This example uses the day/night modes to set a silent mode on an AC unit.



The configuration for heater and fan are similar to scenario 1, a momentary follow can be set. The fan channel can also be linked to the Cooler channel using action 0504 (on when initiator closes, delayed off when initiator opens). This ensures that the fan will continue to work for x amount of seconds after the cooling demand has stopped. For AC's this can be used to *clear* the condenser from excessive moist.



The configuration for the alarms on the input panel can be set to the night and day modes. Also note that only 1 alarm can be active at one time.

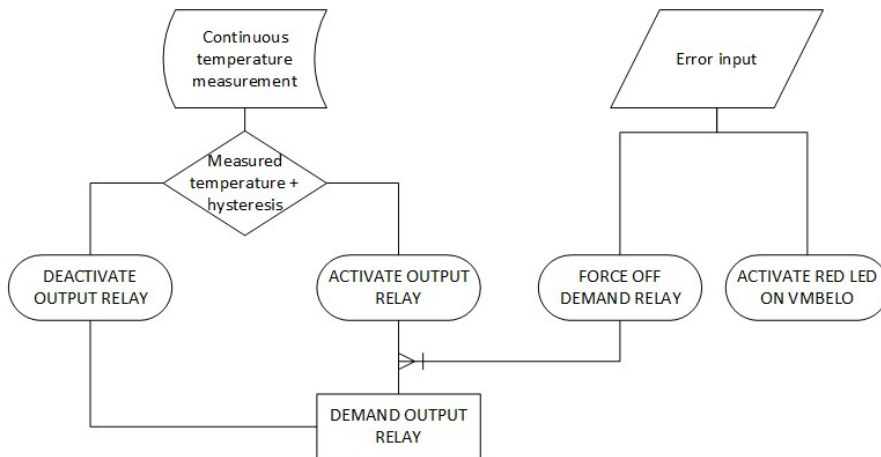


To configure the silent mode, two options exist. Either the night mode alarm (alarm 1) control the silent channel with a Momentarily (follow) mode, or alarm 1 send the 0101 “ON” command and alarm 2 (day mode) send the 0102 “OFF” command.

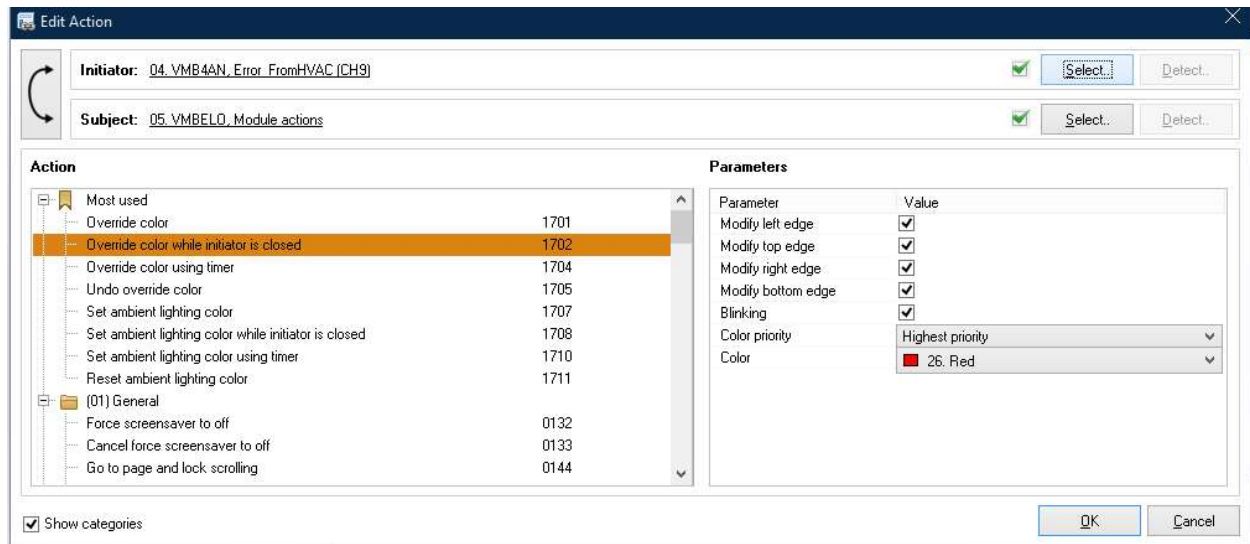
iv.

v. HVAC with error return

The additional input module can be used to trigger further actions in the Velbus system.



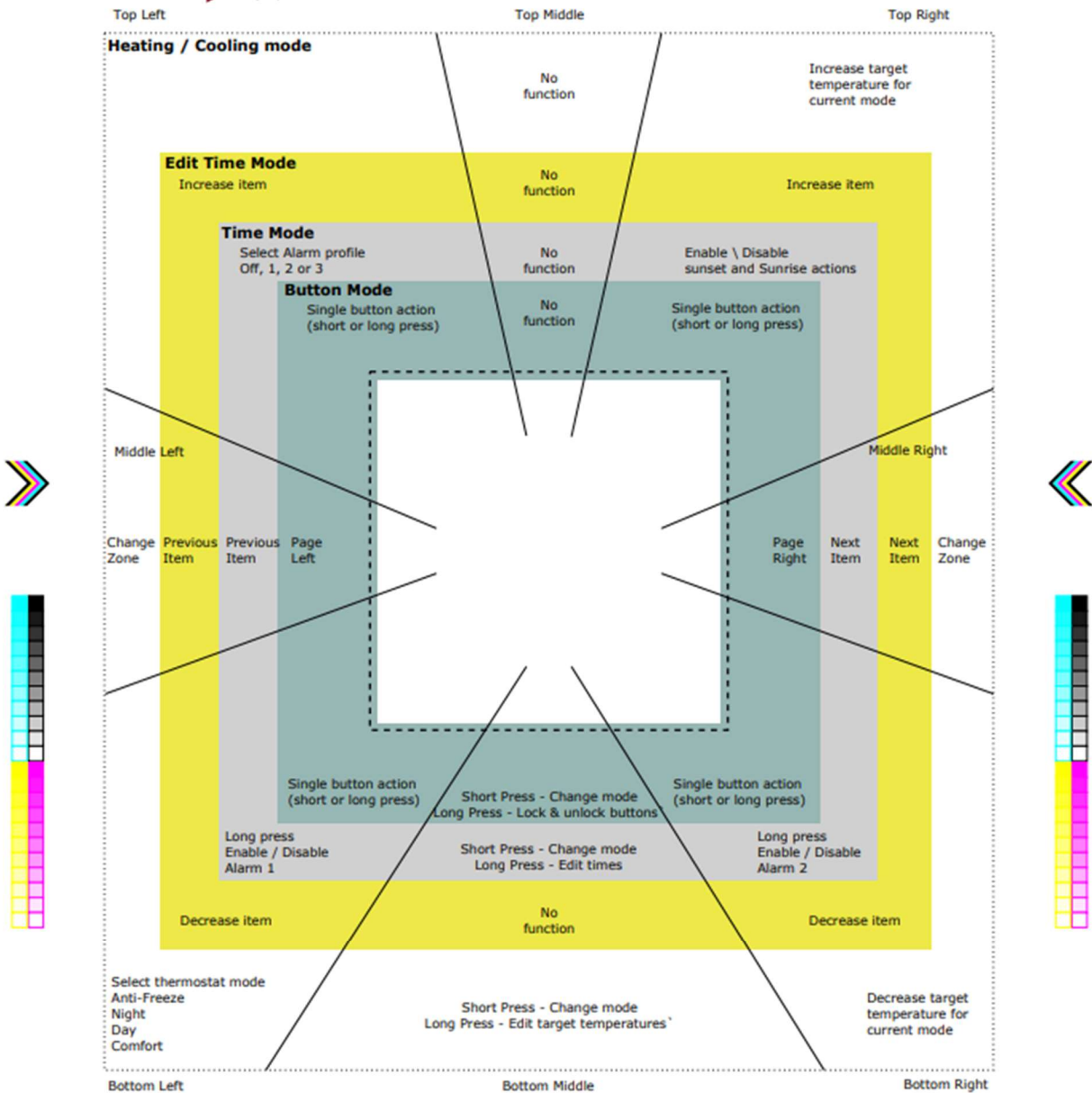
In many cases the error output of a system is based on a relay or voltage output to control external relays. The various Velbus modules allow for a variety of signals from external systems to be integrated into the system.



8. CONCLUSION

There are many possibilities to integrate existing or new HVAC systems into the Velbus domotica system. The various output and input modules can provide simple demand requests to a system, but in many cases the integration can be made much richer, including error-feedback, managing fan speeds etc.

While many systems have a simple demand board, other systems might require additional IO Board accessories to make these actions and integrations available. Advanced integrations into KNX or BACnet can be configured by using IP connections from a central processing unit providing ultra-rich integrations between various systems.



When no longer needed on a daily basis, please remove this guide and store for future reference

More details of the Velbus system can be found at :-
www.velbus.eu and www.mdar.co.uk

Functions available on the VMBELO for controlling thermostat actions.