SeaChange

Consumer Module | Data Sheet V1

VAV Controller
2 x 0-10V DC Outputs

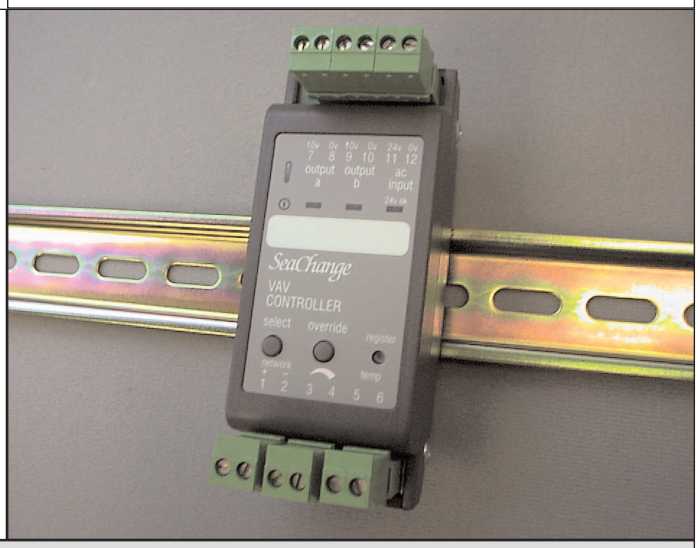
Main Features

Controls VAV Terminal Units

Works in conjunction with Belimo "Compact" Volume controller

Controls a reheat battery (if fitted)

Local User Interface or Actual Volume monitoring options



Detailed Features

General

The VAV Controller controls a Variable Air Volume Terminal Unit (VAV Box); it works in conjunction with a Belimo "Compact" Volume Controller. The Belimo controller has a built-in volume sensor which senses the volume of air flowing through the box. As the pressure in the ductwork system feeding the box fluctuates, the Belimo controller maintains a constant volume through the box; this is called *Pressure Independent* control.

The SeaChange VAV Controller controls the space temperature; it sends a Desired Volume signal to the Belimo Controller via a 0-10V DC output. As the VAV Controller's cooling demand increases, it will send a demand for increasing volume to the Belimo Controller. This technique, where the output from the (SeaChange) Temperature control loop is used as the setpoint for a second (Belimo) volume control loop is called *Cascade Control*.

Operation

A SeaChange Zone Controller must be used to set the operating times for its group of fan coils and to provide an override push button to extend operation outside normal hours using *Occupancy Supervision Interconnects*. Alternatively, the Zone Controller can be used to set both operating times and setpoints for the controllers using *Setpoint Supervision Interconnects*. One Zone Controller has the flexibility to control from 1 to 199 VAV boxes at any one time on a single network.

This makes the SeaChange system equally suited to controlling numerous VAV boxes in a single open plan office zone as it is to providing effective one to one unit zone control for cellular office or hotel bedroom applications.

Because it is modular and incorporates plug and play engineering, a SeaChange VAV control system can be easily and inexpensively adapted to cope with additional zones or VAV boxes changed to work in different zones as offices "churn" over time.

Temperature Control

Temperature control is based on the VAV box's return air temperature (if appropriate) or, more usually a wall-mounted temperature sensor. The sensor is wired to the Controller's input terminals.

Local User Interface

The /001 variant allows the second input to be used for a local user interface. If costs do not allow each VAV box to be provided with a Zone Controller for individual user interface, a combined Temperature sensor, setpoint adjuster and occupancy switch can be applied so that the temperature can be adjusted and the unit turned On/Off locally. Other fan coil controllers can then be controlled as slaves. Diagrams showing these connections are shown on page 3.

Actual Volume feedback

The /002 variant allows the second input to be wired to the 0-10V DC Actual Volume output from the Belimo Controller. This allows the Actual Volume to be monitored (using Doorway Supervisor, or a Zone Controller using User Displays) which can be useful when commissioning; if the Actual Volume is consistently lower than the Desired Volume, this indicates that the box is starved of air, probably indicating that the Supply Air pressure setpoint needs to be increased (see Static Pressure Controller Data Sheet). A future SeaChange development will allow dynamic control of the VAV AHU's volume based on box volume shortfall; contact SeaChange for further details.

V1 Features

Temperature Indicator
indicates how far the controlled temperature is from setpoint.
Green = close to setpoint.
Amber = above setpoint.
Red = below setpoint.

Status Lamp
indicates that the Controller is in Occupancy mode if lit steadily, also indicates that controller is in Configuration Mode (slow flashing) or Maintenance Mode (rapid flashing).

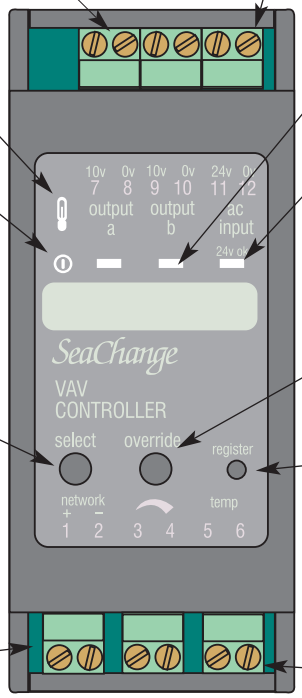
Select
is used during commissioning to allow a Zone Controller to display the Engineering Parameters of this controller. .

Terminals
are all of two-part construction to facilitate wiring connections.

Connections
for network. Belden 8205 Twisted pair, unscreened cable is required. (or exact equivalent)

0-10V DC Output Connectors
for connection to the Belimo Controller (and Reheat Valve if fitted)

Connections
for 24V AC Auxiliary power (powers 0-10V DC outputs)



0-10V DC Status Lamps
indicates the current output levels of the 2 outputs; the lamp glows brighter with increasing output voltage

AC input Status Lamp
indicates the presence of 24V auxiliary supply

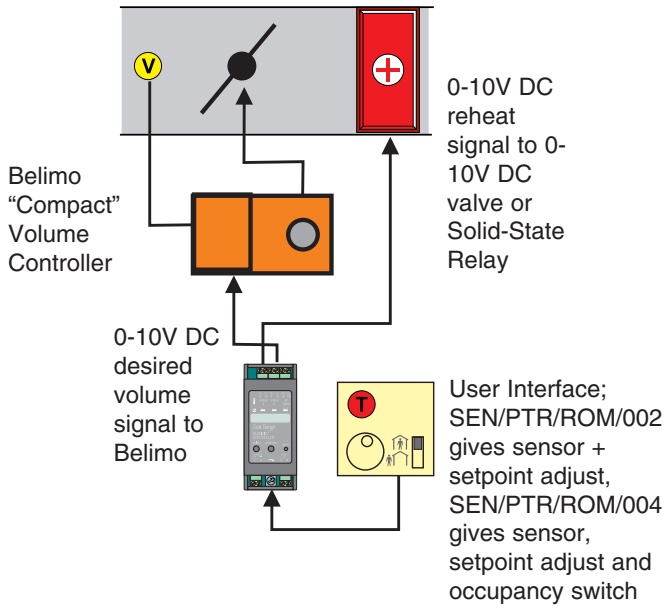
Override
is used to change from Normal to Maintenance mode; Maintenance mode will allow the plant to run without demand signals from the Zone Controllers, which is useful for plant maintenance purposes. (see Detailed Features in this Data Sheet for further information).

Registration Button
is used during the commissioning process to build logical links between controllers

Connections
for return/space temperature sensor and Local User Interface (/001 variant) or Actual Volume signal (/002 variant). Twisted pair, unscreened cable is required.

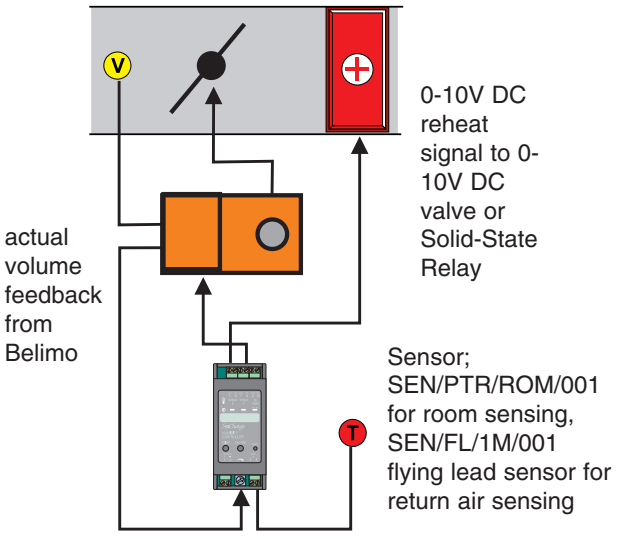
Typical Applications

VAV box with local user interface



Uses VAV/DIN/AOP/001

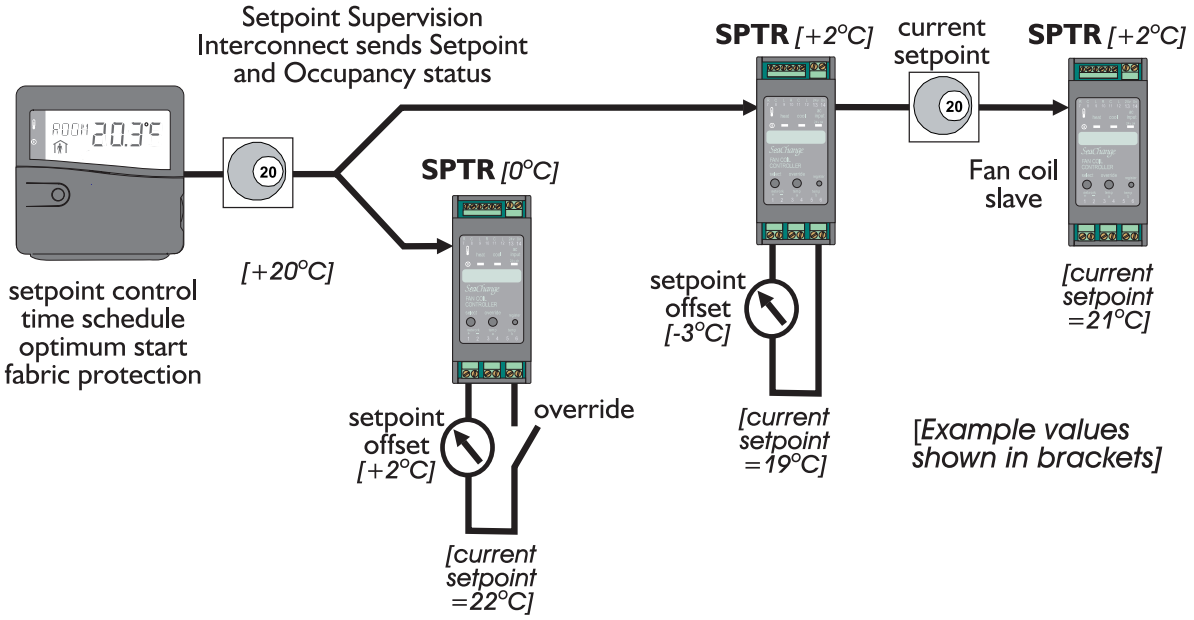
VAV box with Actual Volume feedback signal



Uses VAV/DIN/AOP/002

Master / Slave Operation

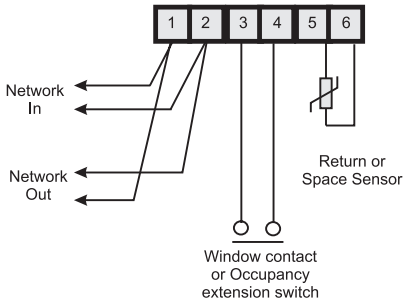
V1



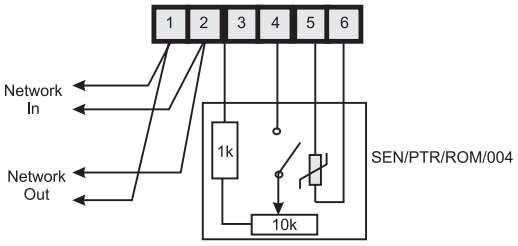
Current setpoint used by a Fan Coil	=	Supervising devices' setpoint	+	**SPTR** setpoint trim (internal parameter range +/-10°C)	+	external setpoint offset - if present (range +/- 5°C)

External Input Options

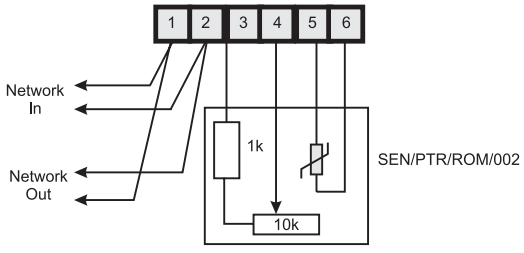
Sensor with optional VFC input (/001 variant only)



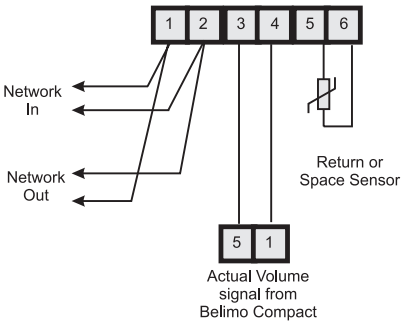
Combined sensor, Setpoint adjust and Occupancy switch (/001 variant only)



Combined sensor and Setpoint adjust (/001 variant only)



Actual Volume feedback signal (/002 variant only)



Temperature Control

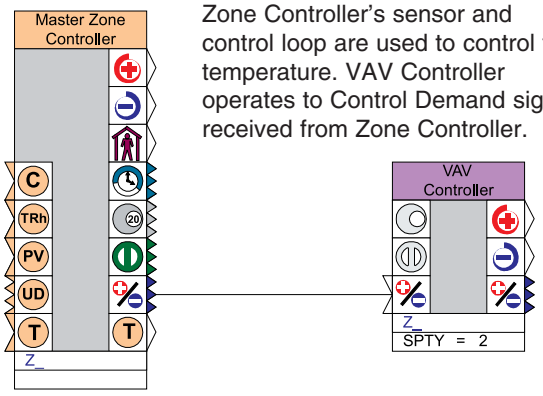
Room / Return Air Control from local sensor

A Return Air (or Room) Temperature sensor must be fitted. The VAV Controller will control Return Air temperature to a fixed setpoint set using Configuration parameter **SPFC**, or an adjustable setpoint, using a Zone Controller (see **Registration**, later). A deadband may be set (using the **SPDB** parameter) which will prevent cycling between heating and cooling and reduce energy usage. This will work with **SPTY** set to 0 or .1

Room Control using a Zone Controller

With no Sensor fitted, the VAV Controller enters “Slave” mode, and will adjust its Desired Volume output for cooling (and reheat valve position, if fitted). on the basis of the Control Demand signals received from the Zone Controller (or “Master” VAV Controller -see later), i.e. if the Zone Controller is demanding 50% Cooling, the Desired Volume will be driven to 50% of its full scale value. (This is called *Open-Loop Control*). This will work with **SPTY** set to 0 or 1

Temperature controlled by Zone Controller



If a sensor is fitted, but it is desired not to use the sensor for control, the VAV Controller can be forced into “Slave” mode by setting **SPTY** to 2; this selects the Control Demand Interconnect connection from the Master to be active, and the Controller will behave as above. The sensor can be used for monitoring.

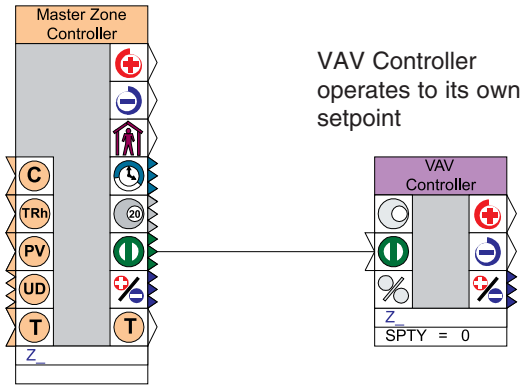
Interconnects

Occupancy Supervision and Local Override

Occupation status for one, or many VAV Controllers (up to 199) are set at a Zone Controller. The Zone Controller holds the Occupation Times, and the Occupancy *Status* is transferred to the VAV Controllers using *Occupancy Supervision* (VAV Controllers do not have their own Occupation Times, you must supervise them from a Zone Controller).

The Zone Controller takes care of Optimum Start and Fabric Protection for the zone of VAV boxes that it is controlling, so it is important that the Zone Controller’s temperature sensor is mounted in a representative part of the space. The VAV boxes will be brought into Occupancy by the Zone Controller during Optimum Start, normal Occupancy period, or because the temperature has dropped and the Zone Controller is in Fabric Protection mode. Also, the Occupancy Times may be overridden by the Override pushbutton on the Zone Controller in the usual way, giving configurable

Occupancy Supervision



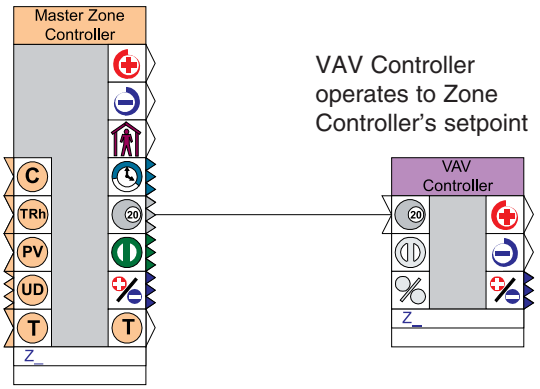
timed extension to occupancy (see Zone Controller Data Sheet).

Additionally, a local switch may be used in order to put the Fan Coil Controller into an Occupied State; this can either be used exclusively to control occupancy (e.g. a Meeting Room) or it can be used in conjunction with a Zone Controller to provide an extension to occupancy. In either case, the Controller requires a maintained contact closure (latching switch) in order to give an Occupied State; if a timed extension is desired, an external timed latching contact must be used. The parameter **INMD** is used to determine whether the external signal is to be used exclusively, or as an OR function with a Zone Controller’s Occupation Times.

Setpoint Supervision and Local Setpoint Adjustment

The VAV Controller may operate to a local setpoint, set on parameter **SPFC**, or alternatively a Zone Controller may be used to determine the Setpoint for one or many Fan Coil Controllers. This is called **Setpoint Supervision**.

Setpoint Supervision



Zone Controller will bring the VAV Controller into Occupation during Occupancy, Optimum Start, Fabric Protection and Occupancy Override

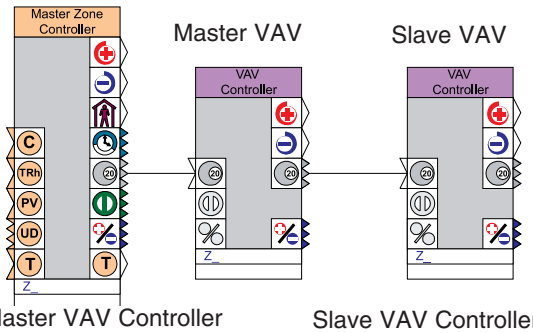
The setting of the **SPTY** parameter determines which value is used for the setpoint; setting SPTY to zero will mean that the Zone Controller will be used for Occupancy Supervision, and its setpoint will be ignored by the VAV Controller (it will use its own local setpoint). Setting SPTY to 1 will enable Setpoint Supervision; adjusting the Zone Controller's setpoint will cause it to be sent to the VAV Controller

A VAV Controller may have a **Local Setpoint Adjuster** which is a simple wall-mounted potentiometer wired directly into the VAV Controller's input terminals; adjusting this will adjust the **offset** value (limited to +/-5 Deg.C). The **offset** value and a value set on the internal parameter **SPTR** are added (or subtracted if the value is negative) to the setpoint set on **SPFC** to produce the operating setpoint for the controller. Note that using a simple potentiometer means that some of the energy saving benefits given by the Zone Controller (e.g. resetting the setpoint to a default value at the start of each occupancy period) are not possible.

Master - Slave VAV Controllers

A VAV Controller can also be used to provide **Setpoint Supervision** for a group of "Slave" Fan Coils; this would be used when an Open-Plan area is fed by several VAV boxes, and only one Local Setpoint Adjuster is required. The Local Setpoint Adjuster is wired to one of the VAV Controllers, which then becomes the "Master" of the group.

Master - Slave VAV Controllers



Master VAV Controller operates to Zone Controller's setpoint but this can be modified by Local Setpoint Adjuster

Slave VAV Controller operates to Master VAV Controller's current

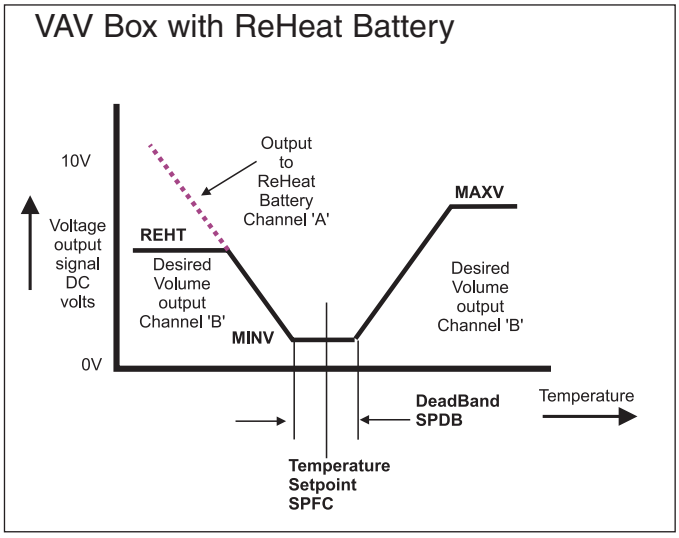
It will send its setpoint set on **SPFC** plus the **offset** applied by the Setpoint Adjuster plus any value set on **SPTR** to all of the "Slave" Fan Coils registered to it (see Master/Slave diagram on page 3) which will then use the resultant value as their own **SPFC** value. Individual trims to this setpoint can be set up in each "Slave" using its **SPTR** parameter, if desired.

Detailed Features

Maximum & Minimum Volume

VAV boxes usually have maximum and minimum design volumes assigned to them by the mechanical designer; the minimum volume ensures a minimum quantity of fresh air enters the space, whilst the maximum volume ensures that the zone does not receive too much air and upset overall system balance. These parameters may be set either using the settings in the Belimo Controller, or by setting the **MAXV** and **MINV** parameters in the VAV Controller. The advantage of the latter method is that the volumes can be adjusted remotely during commissioning or later if the building is altered, and also that this allows for some of the boxes in a system to be turned off if that zone of the building is not occupied.

Normally, when the VAV Controller is out of occupancy, the box will close fully (unless minimum volume settings have been made in the Belimo Controller). This allows the main plant to continue running to serve other zones. If however for mechanical reasons it is necessary for the boxes to remain partly open during non-occupancy, an absolute minimum volume may be set using the **MNVA** parameter; this value applies at all times.



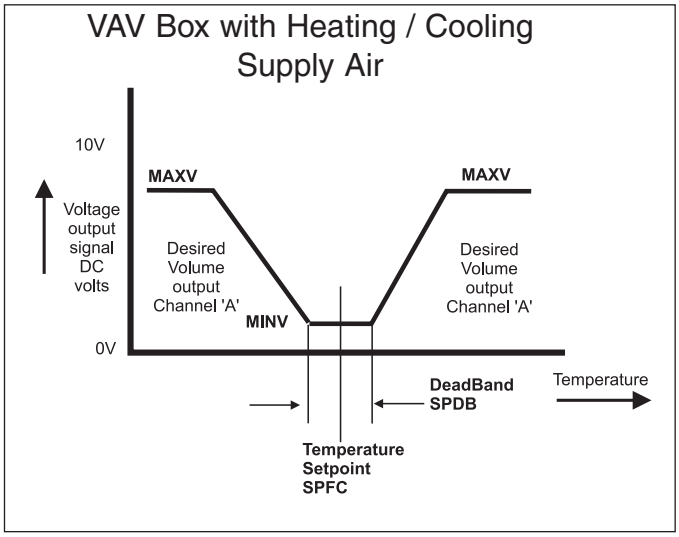
ReHeat Battery control

If a reheat battery is fitted, this may be driven from channel 'A' output, which provides a 0-10V DC signal to drive a valve actuator. Alternatively, if an electric battery is fitted, Engineering Parameters **HYTP** and **HSTG** may be set to allow the use of a Solid-State Relay (SSR). Contact SeaChange for the parameter settings and advice on the type of SSR that you need.

Sometimes, reheat batteries need a minimum air flow over them in order to give full duty which exceeds the minimum fresh air volume set on **MINV**. This can be accommodated by setting parameter **REHT** to the % volume needed by the reheater at full output. As heating demand increases, the reheat output will increase from 0 to 10V, while the Desired Volume output will increase from **MINV** to **REHT**.

Heating / Cooling VAV systems

The VAV Controller may be used in applications where the VAV boxes are being fed with hot or cold air from a central plant, depending on the current demand from the space. The Central Plant may be controlled by a Heat Pump Controller or Floor Controller (see relevant Data Sheets for full details). In brief, the Heat Pump or Floor Controller will collate the demand signals from all of the registered VAV Controllers, and decide on the temperature of the air that they need.



The Heat Pump or Floor Controller measures the Supply Air temperature and broadcasts it on the network; the VAV Controllers receive the information, and will decide whether to open the VAV Box or not. They do this by comparing their current setpoint with the temperature of the Supply Air. If the Supply Air temperature is below the box's current setpoint (less half of the deadband), and the box requires cooling, the box will open; if the Supply Air is at a higher temperature than this and the box requires cooling, the box will remain closed to its minimum volume (as the air would have no effect, or a heating, rather than a cooling effect).

In order to make the VAV Controller check the Supply Air temperature before opening, it is necessary to set the **REHT** parameter (normally used for setting Reheat volume - see ReHeat section) to **-1**.

Also, it is necessary to divert both heating and cooling control outputs to the same physical output channel; this is done by adjusting Engineering Parameters **HYTP** and **HSTG;** contact SeaChange for advice on setting these parameters. Because of this driver signal re-direction, the Desired Volume output is now taken from Channel 'A' (usually the terminals for the ReHeat connection). It is not possible to drive a ReHeat battery when using this mode of operation.

Window Contact, General Alarm or Monitoring

A Volt-free window contact may be wired into the Controller's input terminals and used to disable the VAV box if the Window is opened, preventing energy wastage. This function could also be applied to other inputs which would require the Fan Coil to shut down. Alarms to the supervisor can be enabled or disabled using the **ALRM** parameter; the **ALST** parameter is used to set the contact sense. I.e. whether an opening or closing contact will generate an alarm.

The Input may be alternatively used for general monitoring, either with or without alarm generation

The correct mode of operation is determined by the **INMD** parameter.

Alarm Handling

The VAV Controller may be set to ignore alarm conditions, report them to a SeaChange Doorway Supervisor (either locally connected to the system, or via an autodialling modem), or to both report alarms and take some control action. The **ALRM** parameter is used to select the desired Alarm Mode, whilst **ALST** is used to set the sense (i.e.. whether a closing or opening contact generates an alarm).

The VAV Controller generates an alarm if the sensor fails and also if the external alarm input is used.

The VAV Controller may be set to respond to the **STOP** System Stop Alarm which is generated by a Boiler Controller; this can be used to shut down the entire control system, or parts of it, if a particularly critical event occurs.

Alarm codes as they appear at Doorway Supervisor:

SENF Sensor failed;
(only sent if SPTY set to 0 or 1)

EXTN External alarm generated by VFC input;
(/001 variant only)

STOP STOP alarm received;
(outputs shut down)

NOAL No Alarms; all alarm conditions cleared in this Module

Registration and Commissioning

Registration is the simple process by which logical connections are made between Controllers in a SeaChange system; it is done during commissioning and involves pressing buttons on the Controllers in a specific sequence.

For further details of the registration process, see our 'Design and Commissioning Guide' publication.

Address Allocation and System Housekeeping

Like all SeaChange Controllers, the VAV Controllers must be registered with other modules in order to create a working system. During the Registration procedure, the address of each Controller is allocated by the module that contains *System Housekeeping.* Check that you have an appropriate System Housekeeping Module; see our 'Design and Commissioning Guide' publication.

Interconnects

The VAV Controller must receive signals from a Zone Controller, either Occupancy Supervision or Setpoint Supervision, or Control Demand signals (see Temperature Control section). It may also send signals to other modules (e.g. a Heating Demand signal to the Module which provides hot water for its ReHeat Battery)

These Interconnects are put in place by Registration; again, see our 'Design and Commissioning Guide' publication.

V1 Configuration Parameters

Label	Doorway Code	Description	Units	Default Value	Range
SPFC	C1	Occupied room temperature setpoint	Deg C	20	10 to 35
SPDB	C2	Setpoint Deadband	Deg C	1.0	0 to 10
SPTR	C3	Setpoint Trim	Deg C	0	-10 to +10
SPTY	C4	Setpoint type 0: Local from C1, occupancy supervised from a master Zone Controller 1: Setpoint (and occupancy) supervised from master Zone Controller 2: Room control from remote Zone Controller;outputs controlled from Heat%, Cool% Control Demands	-	1	0 to 2
INMD	C5	Input mode for terminals 'temp a' 0: Supply temperature 1: Time clock AND window contact (short = occupied) 2: Time Clock OR internal clock 3: External Occupation signal only 4: Alarm Input	-	0	0 to 4
MAXH	C6	not used in this application	Deg C	30	0 to 90
MINH	C7	not used in this application	Deg C	20	0 to 90
MAXC	C8	not used in this application	Deg C	18	2 to 30
MINC	C9	not used in this application	Deg C	10	2 to 30
MIND	C10	Supply minimum demand, used for switching between heating and cooling	-	4	0.0 to 10.0
OCCO	C11	When set, controller will only run during the Occupied Period	-	0	0 to 1
HPRD	C12	not used in this application	Secs/10	6	1 to 60
HDLY	C13	not used in this application	Minutes	0	-30 to + 30
CPRD	C14	not used in this application	Sec/10	6	1 to 60
CDLY	C15	not used in this application	Minutes	0	-30 to +30
FPRD	C16	not used in this application	Secs/10	12	1 to 60
FRPT	C17	Frost Protection 0 = No Action, 1 = Open Heating Valve to 50% 2 = Open Heating Valve to 50%	-	0	0 to 2
MANL	C18	Manual Level from Doorway	-	0	-100 to +100
HTSC	C19	Heat Source	-	0	-1 to 100
CLSC	C20	Cool Source	-	0	-1 to 100
HTCT	C21	CT Setpoint when sending Heating Demand to another Module	Deg C	0	0 to 100
CLCT	C22	CT Setpoint when sending Cooling Demand to another Module	Deg C	0	0 to 20
MAXV	C23	Maximum Box Volume during Occupancy	%	100	5 to 100
MINV	C24	Minimum Box Volume during Occupancy	%	25	0 to 50
REHT	C25	ReHeat; 0: no ReHeat fitted -1: Check Supply Air Temperature before opening Box 1 to 100: Maximum Box Volume when ReHeating			
ALRM	C26	Alarm Mode 0: Ignore alarms 1: Alarms reported no other action 2: Control output set to zero on alarm 3: STOP alarm recognised control set to zero	-	1	0 to 3
ALST	C27	Not used in this application			

Pre Commissioning Checks

Power Up

On initial power up of the module there will be delay of between 10 to 60 seconds before the temperature LED lights. This delay has been incorporated so that when many VAV boxes are controlled on the same circuit their power requirements will be spread over this period.

Monitoring Parameters

V1

Label	Doorway Code	Description	Units	Default Value	Range
INPA	I1 (C30)	Input A status; status of VFC input	-	-	0 to 1
OCCD	I2 (C31)	Occupied	-	-	0 to 1
COOL	I3 (C34)	Cooling Status	-	-	0 to 1
RLYA	I4 (C35)	not used in this application	-	-	0 to 1
RLYB	I5 (C36)	not used in this application	-	-	0 to 1
RLYC	I6 (C37)	not used in this application	-	-	0 to 1
AUTO	W1 (C38)	Automatic/Manual Status	-	-	0 to 1
OVRD	W2 (C39)	Override	-	-	0 to 1
HAND	W5 (C42)	Manual Hand; use with MANL to set output level	-	0	0 to 1
POT	W6 (C43)	Set to a 1 if on-board pot fitted to PCB (SeaChange use)	-	0	0 to 1
SERV	W7 (C44)	Service Pin Message (to Doorway) (self resetting after use)	-	-	0 to 1
CGST	W8 (C45)	Configuration Mode Status	-	-	0 to 1
VOLM	S1* (C50)	Current Box Volume	%	-	0 to 100
RTNA	S2* (C51)	Return Air Temperature	Deg C	-	-
HCOP	S3* (C52)	Heat Cool Output	%	-	0 to 100
SPSL	S4 (C53)	not used in this application	Deg C	-	-
SPRT	S5 (C54)	Current Return Setpoint	Deg C	-	-
HDMD	S6 (C55)	Heat Demand from Room Loop (or Zone Controller)	%	-	0 to 100
CDMD	S7 (C56)	Cool Demand from Room Loop (or Zone Controller)	%	-	0 to 100
SPOC	K1 (C60)	Occupation Setpoint	Deg C	20	5.0 to 35.0
SPNO	K2 (C61)	Non-Occupation Setpoint	Deg C	10	5.0 to 20.0
SPSV	K3 (C62)	Supervised Setpoint from Master Controller	Deg C	-	0 to 35.0
SPTR	K4 (C63)	Setpoint Trim	Deg C	0	-10.0 to +10.0
MXVA	K5 (C26)	Maximum Voltage output on Channel 'A' (at all times)	%	10	0.0 to 10.0
MNVA	K6 (C27)	Minimum Voltage output on Channel 'A' (at all times)	%	0	0.0 to 10.0
MXVB	K7 (C28)	Maximum Voltage output on Channel 'B' (at all times)	%	10	0.0 to 10.0
MNVB	K8 (C29)	Minimum Voltage output on Channel 'B' (at all times)	%	0	0.0 to 10.0
		Engineering Parameters; only accessible via Doorway			
NOAL	C90	No Alarms; all alarms cleared when set to 1	-	-	0 or 1
SENF	C91	Sensor Failed (when set to 1)	-	-	0 or 1
NOAL	C92	Volt-Free Contact alarm (when set to 1)	-	-	0 or 1
NOAL	C93	STOP alarm received (when set to 1)	-	-	0 or 1

* 24 hour plots available for these values

Manual Override

Allows the outputs to be exercised during commissioning and maintenance activities. Holding the Manual Override button pressed until the Status Lamp flashes green will cause the controller to be switched from automatic to manual control and the Box will control to normal setpoint. This is called *Occupancy Override* mode

Subsequent pressings of the manual override button will cause *Manual Hand* mode to be selected:

Press	Temp Lamp	Output
1	Red	Manual Hand 100% Heating selected
2	Yellow	Manual Hand 100% Cooling selected
3	Green	returns to Auto Control

As this feature does not time out, care should be exercised to ensure the module is returned to the automatic mode on completion of the commissioning or maintenance activities.

Manual Override can also be achieved via Doorway;

1) **AUTO** and **OVRD** can be used together to put the Controller into Occupancy Override mode using the syntax:

[Z*n*]W1(S)/auto/override/10/12/W2(S)

When clicked, this brings up the ON/OFF/AUTO dialog box which allows the user to select Override ON, Override OFF or Automatic control.

The screen display will show override (in red) or auto (in green).

2) **HAND** and **MANL** can be used together to put the controller into Manual Hand mode using the syntax:

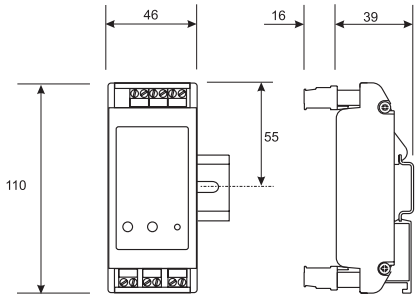
[Z*n*]W5(S)/hand/auto/12/10/C83(V)

Clicking on the point will bring up a dialog box which allows hand or auto to be selected with radio buttons and the output level to be set in a text box or using the slider controls. The output can be set between -100, full cooling through to +100 full heating.

The screen display will show hand (in red) or auto (in green).

V1 Specification

Dimensions



all dimensions in mm

Electrical

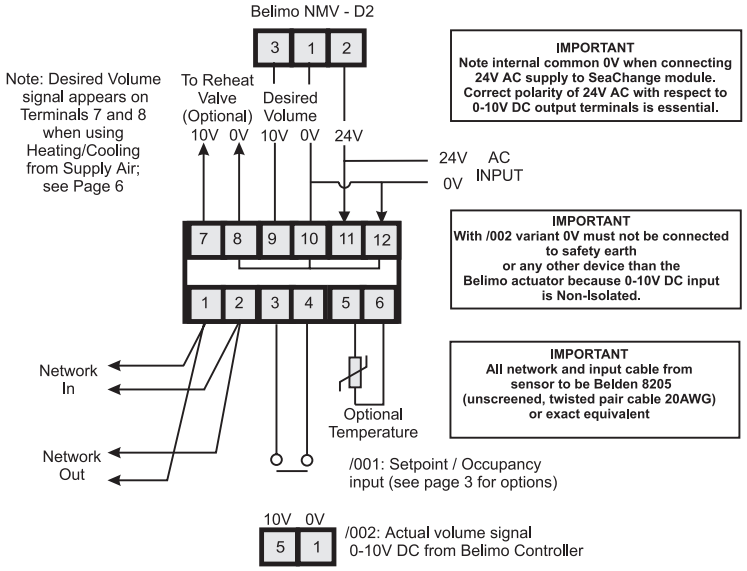
Inputs;	/001:	1Thermistor and VFC or potentiomenter.
	/002:	1Thermistor and 1 0-10V DC input (non-isolated)
Outputs:		2 x 0-10V DC outputs
Consumption:		7 mA from network 50mA from 24V AC supply

Physical

Weight	0.15 kg
Cover Material	PC/ABS alloy Self extinguishing to UL 94 V0/1.60
Base Material	Polyamide 6.6 Self extinguishing to UL 94 VO
Colour	Dark Grey to Pantone 425

CE Conformant product

Wiring Information



Options and Product Codes VAV Controller

VAV / DIN / AOP / 001 VAV controller with 0 - 10V DC outputs for desired volume and optional reheat battery, with thermistor input for space temperature sensor and second input for Setpoint/VFC options.

VAV / DIN / AOP / 002 VAV controller with 0 - 10V DC outputs for desired volume and optional reheat battery, with thermistor input for space temperature sensor, 0 - 10V DC input for actual volume signal from Belimo controller.

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