OpenAir™

VAV controller ASV181.1E/3

- **Controller for plants with variable or constant airflow**
- **Consisting of static differential pressure sensor and configurable digital air volume controller with P-control**
- **Operating voltage AC 24 V**
- **For connection to an OpenAir™ family 3-position air damper actuator with high torque and safety function**
- **Prewired with 1x 0.9 m and 1x0.3 m connecting cables**

Note

Please refer to the Technical Basics in document Z4634en for a detailed description as well as information on safety, engineering notes, mounting and commissioning

Use

Used primarily to control the room temperature in individual rooms and zones of ventilation and air conditioning plants working with variable or constant volumetric airflows, and the air volume is required as an auxiliary controlled variable[1)].

1) To keep constant the volumetric airflow on pressure fluctuations in the system

The VAV controller is used for:

- Supply air control
- Extract air control
- Supply/extract air cascade control with
  - ratio control 1 : 1
  - ratio control 1 ≠ 1 (over-/underpressure)
  - differential control 1 ≠ 1 (over-/underpressure)

Ordering

When ordering, please give type reference of the VAV controller.

Equipment combinations

Unit	Typ reference	Datasheet
Room temperature controller	**RCU6...**	3046
POLYGYR® and CLASSIC range		3551, 3390
TEC™ range		3601
DESIGO™RX range		38xx
OpenAir™ 3-position actuators AC 24 V	**GIB/GBB/GCA13...1E**	4625, 4626, 4627
	GMA/GEB13...1E	4614, 4621
Setting unit	**AST10**	5851
Interface converter	**AST11**	5852

Technical design

The VAV controller can be used with or without integrated air volume controller.
The following parameters are available in the unit:

Parameter	Range	Factory setting
Function type	• **con** (differential pressure sensor with controller) • **3P** (differential pressure sensor without controller)	**con**
$\dot{V}_n$ = correction factor for nominal volumetric airflow	1...2,55	1
$\dot{V}_{min}$ [1)] = minimum volumetric airflow	−20...+100 %	0 %
$\dot{V}_{max}$ [1)] = maximum volumetric airflow	20...120 %	100 %
Actuator rotary direction	Counter-clockwise / clockwise	Clockwise

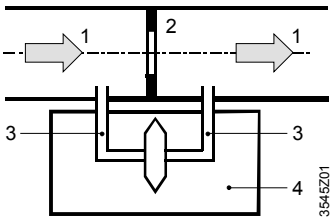
1) The $\dot{V}_{min}$ and $\dot{V}_{max}$ percentage values refer to $\dot{V}_n$.

The parameters can be set as follows:

- With setting unit **AST10** via terminal YC with digital communication, or the service tool connector, or
- With a laptop equipped with calibration software **ACS931** and interface converter **AST11**, via terminal YC with digital communication, or the service tool connector.

Mode of operation
DC 0...10 V control (e.g. with room temperature controller **RCU61...**)

The VAV controller together with the **RCU61...** forms a room temperature cascade controller using the room temperature as the main controlled variable and the air volume as the auxiliary controlled variable.
With this type of control, the deviation of the room temperature determines the setpoint of air volume. The air volume is then maintained at the setpoint by the auxiliary control, that is, the pressure variations in the ductwork, which appear as a disturbance variable, have no impact on the air volume and, therefore, no impact on the room temperature.
The control mode for the auxiliary controlled variable "Air volume" is P (proportional).
The VAV controller acquires the actual value of the volumetric airflow via the differential pressure Δp by means of a membrane sensor. The differential pressure is converted electronically to a volumetric flow signal, which is made available at output U (core 9-1) in the form of a DC 0...10 V output signal (e.g. for volumetric airflow indication).



Legend

1 Actual value of volumetric airflow
2 Flow resistance in the duct (schematically)
3 Measuring line
4 Static (membrane) differential pressure sensor

Variable (VAV) or constant (CAV) air volume control

The use of input YC defines the type of air volume control.
The following tables show the impact of the kind of use of inputs Y… on the type of control and forced control.

VAV/CAV control with configuration "con"				
Configured actuator rotary direction	Counter-clockwise /clockwise	Counter-clockwise /clockwise	Counter-clockwise /clockwise	Counter-clockwise /clockwise
YC (core 8-1)	DC 0...10 V	DC 0...10 V	Open	Open
Y1 (core 6-1)	Open	G0	Open	G0
Y2 (core 7-1)	Open	G0	Open	G0
Type of control	**VAV** control with DC 0...10 V setpoint shift	**VAV** control with DC 0...10 V setpoint shift	**CAV** control at $\dot{V}_{min}$	**CAV** control at $\dot{V}_{max}$

VAV/CAV forced control with configuration "con"				
Configured actuator rotary direction	Clockwise	Counter-clockwise	Counter-clockwise	Clockwise
YC (core 8-1)	DC 0...10 V or open	DC 0...10 V or open	DC 0...10 V or open	DC 0...10 V or open
Y1 (core 6-1)	G0	G0	Open	Open
Y2 (core 7-1)	Open	Open	G0	G0
Forced control	Y11 active (Clockwise damper full open)	Y22 active (counter-clockwise damper fully open)	Y11 active (clockwise damper fully closed)	Y22 active (counter-clockwise damper fully closed)

VAV control

The DC 0…10 V signal at input YC is the compensating variable for the setpoint of the volumetric air volume. It determines the required volumetric airflow within the limits of $\dot{V}_{min}$ and $\dot{V}_{max}$.

CAV control

Depending on the circuitry (open/closed) of inputs Y1(core 6-1) and Y2 (core 7-1), the required CAV level is maintained. When the input is open, the VAV controller maintains $\dot{V}_{min}$; when inputs Y1 and Y2 are closed, $\dot{V}_{max}$ is maintained.

Adjustment of nominal volumetric airflow ($\dot{V}_n$)

Using parameter $\dot{V}_n$, the box manufacturer can match the measurement range of the VAV compact controller to the respective nominal air volume of the air boxes.
100 % nominal air volume of the air box then corresponds to DC 10 V of the measurement range of the VAV controller. This adjustment can be checked at output U (core 9-1)

Minimum and maximum limitation of air volume

With the aid of setting parameters $\dot{V}_{min}$ and $\dot{V}_{max}$, the air volume can be limited to a minimum and maximum.

Overpressure / underpressure setting

With supply/extract air control, a room overpressure or underpressure up to 20 % max. at equal duct cross sections and pressure ranges with the aid of parameters $\dot{V}_{max}$ and $\dot{V}_{min}$ of the cascade controller.

Compensation of different duct cross sections

With supply and extract air control, parameters $\dot{V}_{max}$ and $\dot{V}_{min}$ allow for duct compensation of max. 20 %.

Forced air damper control

The circuitry of signal inputs Y1 and Y2 enables the air dampers to fully open or fully close, independent of $\dot{V}_{max}$ and $\dot{V}_{min}$.

Complete shut-off of volumetric airflow

Complete shut-off of the airflow takes place via digital signal input Y2. If this input is connected to ground (G0) and if signal input Y1 is open, complete shut-off is provided without giving consideration to $\dot{V}_{min}$.
This is a signal triggered by an external switching contact (e.g. a DDC switching command, window switch, or similar).
A complete shut-off of volumetric flow also takes place at YC = 0 V and $\dot{V}_{min} \leq 0$ %

Mode of operation only with differential pressure sensor

To use the device as a differential pressure sensor only, the "Function type" parameter must be set to "3P".
Make this setting with the **AST10** or the calibration software **ACS931**.
To enable the parameter change to become active, the power supply (AC 24 V) must be briefly interrupted after the change.
With this function type setting also, the device acquires the actual value of the volumetric airflow in the air duct via the differential pressure Δp with the help of its static differential pressure sensor. The differential pressure is converted electronically into an air volume signal which is made available at output U (core 9-1, pink) as a DC 0..10 V signal (actual value of volumetric airflow).
The control air volume controller of the device is deactivated.
Air damper control (3-position) is accomplished via signal inputs Y1 (core 6-1, violet) and Y2 (core 7-1, orange). The commands for the air damper control drive are looped through to control outputs Y11 (core 6-2, violet) and Y22 (core 7-2, orange).

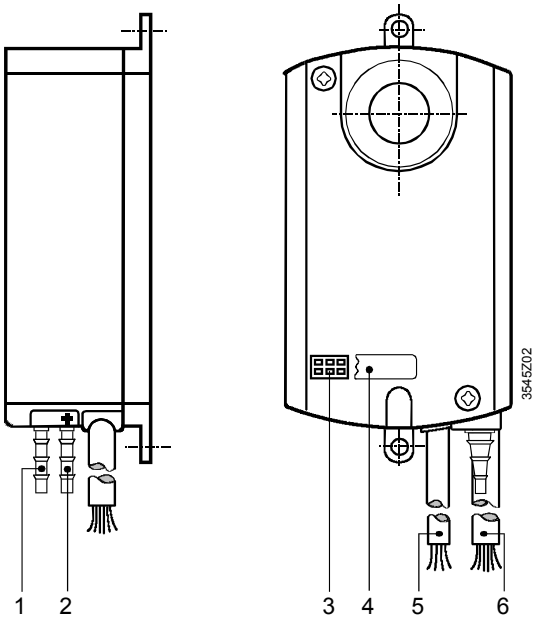
Mechanical design

The VAV controller is suited for wall mounting.
It consists of a two-sectional housing, the housing floor and the housing cover.
The housing is made of robust plastic. The cover may not be removed. The following components are located underneath the cover:

- The controller electronics.
- The membrane pressure sensor with electronic circuit.

The electrical connection is made via two fixed connecting cables which exit the housing at the bottom of the device. The cable ends are provided with ferrules.

Setting, operating and connecting elements



Legend

1 Measuring element connection for a connecting tube (inside dia. 3...6 mm) to the nipple for the low pressure of the measuring cross on the box.
2 Measuring element connection (+) for a connecting tube (inside dia. 3...6 mm) to the nipple for the high pressure of the measuring cross on the box.
3 Socket for service tool (6-pole) for **AST10** and **AST11.**

4 Cover for service tool socket.
5 Connecting cable 2 (4-core) to the OpenAir™ 3-position actuator.
6 Connecting cable 1 (6-core) to the room controller.

Disposal

For environmentally compatible disposal, the larger plastic parts are labelled as per ISO/DIS 11 469.

Engineering notes

⚠

AC 24 V operating voltage is necessary for powering the VAV controller.

- The operating voltage must comply with the requirements for safety extra-low voltage (SELV) or protection by extra-low voltage (PELV).
- Use safety insulating transformers with double insulation; the transformers must be suited for 100 % on time.

All local safety regulations for sizing and protecting transformers must be complied with.

The VAV controller may only be connected to an OpenAir™ air damper actuator.

Caution, maintenance

The VAV controller may not be opened!
The controller is maintenance-free. If its housing is opened, the product guarantee becomes void.

Setting values

The setting values of $\dot{V}_n$, $\dot{V}_{max}$, $\dot{V}_{min}$ and the actuator's direction of rotation (clockwise or counter-clockwise) must be entered in the plant documentation.

Mounting notes

Mounting orientation

The mounting orientation is optional. It must be ensured, however, that the housing will be accessible (service tool connection socket!).

Service tool connection

The cable connection for YC must be accessible for the **AST10** setting unit or the **AST11** interface converter (e.g. connection terminal in the control panel).

Environmental conditions

Observe the permissible ambient temperature and the humidity (refer to "Technical data").

Mounting instructions

The VAV controller is delivered with mounting instructions.

Commissioning notes

- Check the mechanical settings as per the plant-specific requirements and especially to ensure that the dampers close tight.
- Check the direction of rotation.
- Check the lines for differential pressure measurement for correct connection
- Setting unit **AST10** or the calibration software **ACS931** with interface converter **AST11** are required for checking or adjusting the setting values of $\dot{V}_n$, $\dot{V}_{max}$, $\dot{V}_{min}$ and the actuator's direction of rotation (counter-clockwise or clockwise).
  After detaching the **AST10** or **AST11** from the VAV compact controller, it takes one minute for YC, Y1 and Y2 to work as per the specifications.
- The sensor output signal is only correct after a maximum of two minutes following application of AC 24 V operating voltage or after interruption of power supply. During that period of time, the VAV controller makes a zero point calibration of the differential pressure sensor.
- If the **AST10** or **AST11** is connected to YC, any cable for the DC 0…10 V (setpoint) signal connected to that output must be disconnected for the time the communication takes place!

Technical data

General data

Power supply G (core 1-1 red) and G0 (core 2-1 black)	Operating voltage	AC 24 V ±20 %
	Safety extra-low voltage (SELV) or protection by extra-low voltage (PELV) as per	HD 384
	Requirements of external safety insulating transformer (100 % on time)	EN 60 742
	Frequency	50/60 Hz
	Supply line fuse	max. 10 A
	Power consumption (when drive is not connected)	6 VA/3.5 W
Signal inputs		
Volumetric airflow reference signal or communication signal YC (core 8-1 grey)	Input voltage	DC 0…10 V
	Max. permissible input voltage	DC 35 V
	Limited to	DC 11 V
	For complete closure in VAV range, at $\dot{V}_{min} \leq 0$ %	DC −1.5...−0.2 V
	Input resistance	> 100 kΩ
	Neutral zone NZ	200 mV
	Protected against false wiring	max. AC 24 V
	Communication signal type	PPS2
Positioning signals Y1 (core 6-1 violet) and Y2 (core 7-1 orange)	Contact sensing	
	Contact open	DC 30 V contact voltage
	Contact closed	DC 0 V, 8 mA contact current
	Protected against false wirin	max. AC 24 V
Signal outputs		
Volumetric airflow measuring signal U (core 9-1 pink)	Output voltage "measuring signal"	DC 0…10 V
	Limited to	DC 12.8 V
	Max. current	DC ±1 mA
	Protected against false wirin	max. AC 24 V
3-position output signal [1] Y11 (core 6-2 violet), Y22 (core 7-2 orange)	Output voltage	AC 0/24 V
	Max. current load	500 mA
	Max. cable length between ASV181.1E/3 and OpenAir™ actuator	3 m
Actuator supply [2] G (core 1-2 red) G0 (core 2-2 black)	Operating voltage	AC 24 V ±20 %
	Frequency	50/60 Hz
Connection services tool	Terminal strip	2 x 3-pole, spacing 2.54 mm
Connecting cable 1	Cable length	0.9 m
	Number of cores	6
	Core cross section	0.75 mm^2
Connecting cable 2	Cable length	0.3 m
	Number of cores	4
	Core cross section	0.34 mm^2
Material and colors	Housing floor	ABS 17GF Cycolac CRT3370 silver gray RAL 7001
	Housing cover	ABS Cycolac light gray RAL 7035
Protection and safety	Degree of protection of housing	IP54 as per IEC 529
	Safety class	III as per EN 60 730

Environmental conditions	Operation as per	IEC 721-3-3
	Climatic conditions	class 3K5
	Mounting location	interior, weather-protected
	Temperature	0....50 °C
	Humidity (non-condensing)	< 95 % r.H.
	Transport as per	IEC 721-3-2
	Climatic conditions	class 2K3
	Temperature	–25...+70 °C
	Humidity (non-condensing)	< 95 % r.H.
	Mechanical conditions	class 2M2

Standards

Product safety	Automatic electrical controls for household and similar use (type 1)	EN 60 730-2-14
Electromagnetic compatibility	Immunity	IEC 61 000-6-2
	Emissions	EN 50 081-1
CE conformity as per	EMC directive	89/336/EEC
	Low voltage directive	73/23/EEC
C-Tick conformity as per	Australian EMC Framework	Radio communication act 1992
	Radio Interference Emmission Standard	AS/NZS 3548
Dimensions	W x H x D	68 x 135 x 45 mm
Wight	without packaging	0.28 kg
	with packaging	0.32 kg

Controller	3-position controller with hysteresis	
	Max. air volume $\dot{V}_{max}$ (adjustable)	20...120 %
	Min. air volume $\dot{V}_{min}$ (adjustable)	–20...+100 %
	Nominal air volume $\dot{V}_n$ correction factor	1.00...2.55
Sensor	Measurement range	0...300 Pa
	Accuracy across 2...100 % of the pressure range	
	at 25 °C, $\dot{V}_n$ = 1 and any mounting position	±2.5 % of measurement range
	Time constant	1 s
	Max. permissible operating pressure	3000 Pa
	Max. permissible side load	3000 Pa

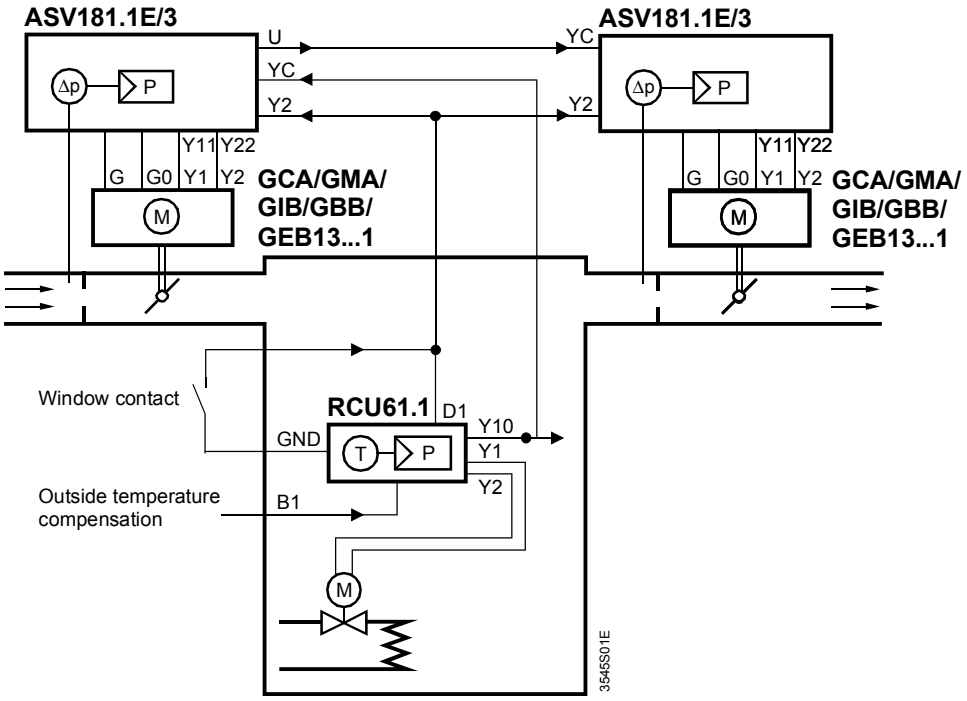
1) The triacs can be destroyed if there is a short circuit or false wiring at 3-position outputs Y11, Y22
2) The outputs G and G0 are not short-circuit-proof

Note

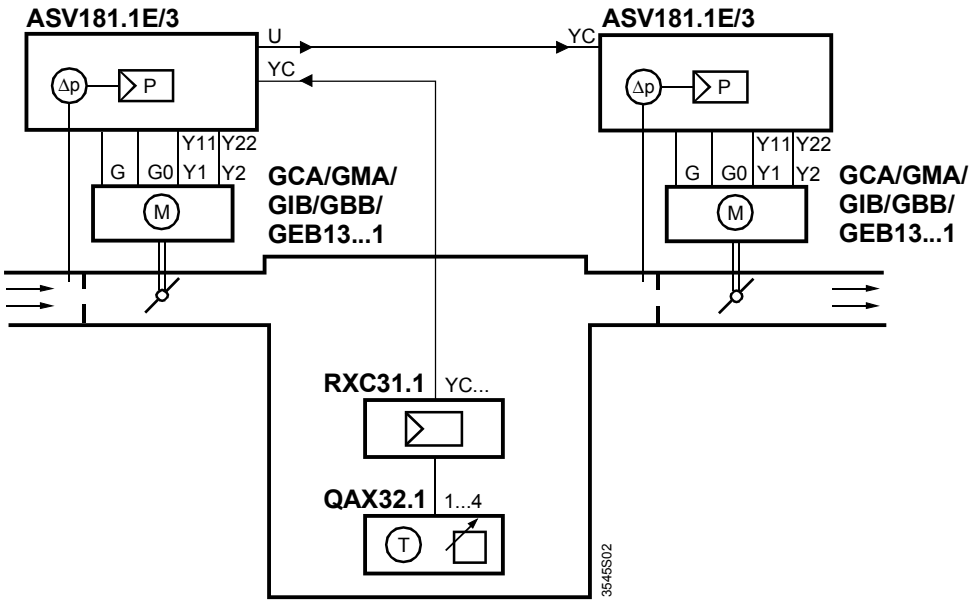
The illustrations only show the basic connections of signal lines. Switch-off functions and manipulations are not part of the illustrations as they differ from plant to plant. The G0 connection between ASV181.1E/3 and the G…13…1 OpenAir™ actuator is only required for OpenAir™ actuators with spring returns.

Plant example 1
Function type "con": control loop without communication (DC 0...10 V control by room temperature controller RCU61.1)

If a window switch connected to input Y2 (core 7-1) of the **GDB.../GLB...** or D1 of the **RCU61.1**, is open, the meaning is the following: the window is closed so that comfort operation is required. On an application with full shut-down of the volumetric airflow, input Y2 (core 7-1) of the main controller and secondary controller must be connected.



Plant example 2
Function type "con": control loop with communication. (DC 0...10 V control by DESIGO™ RX room temperature controller combination)



Setting example 1

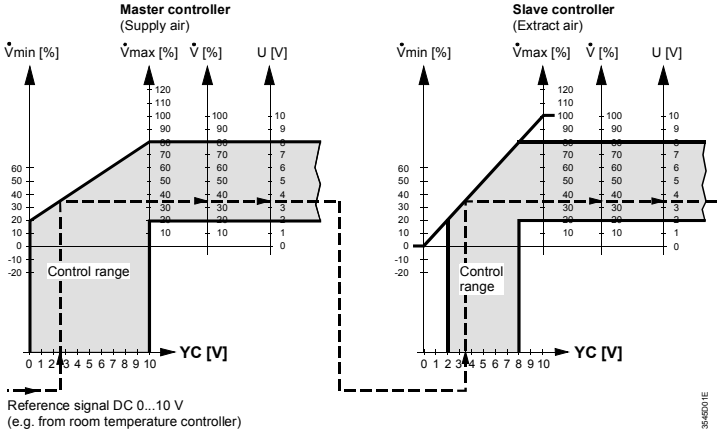
VAV differential pressure control 1 : 1

Master (supply air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Slave (extract air): $\dot{V}_{min}$ = 0 %, = $\dot{V}_{max}$ 100 %, $\dot{V}_n$ = 1

Reference signal: Y20 = 2.5 V

Result: $\dot{V}_{master}$ = 35 %, $\dot{V}_{slave}$ = 35 %



Setting example 2

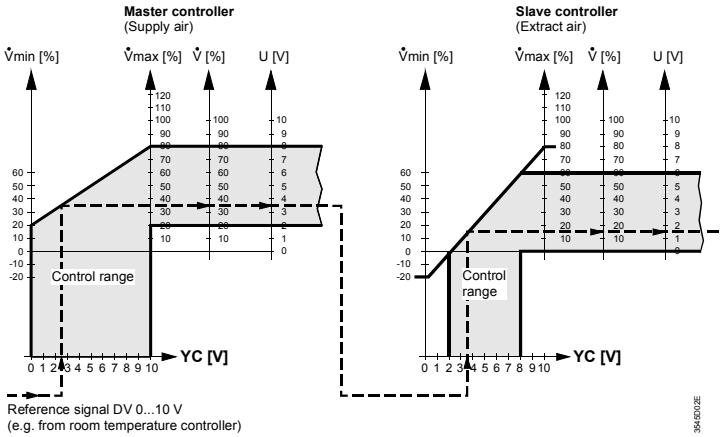
VAV differential pressure control 1 ≠ 1, with 20 % room overpressure

Master (supply air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Slave (extract air): $\dot{V}_{min}$ = –20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Reference signal: Y20 = 2.5 V

Result: $\dot{V}_{master}$ = 35 %, $\dot{V}_{slave}$ = 15 %



Setting example 3

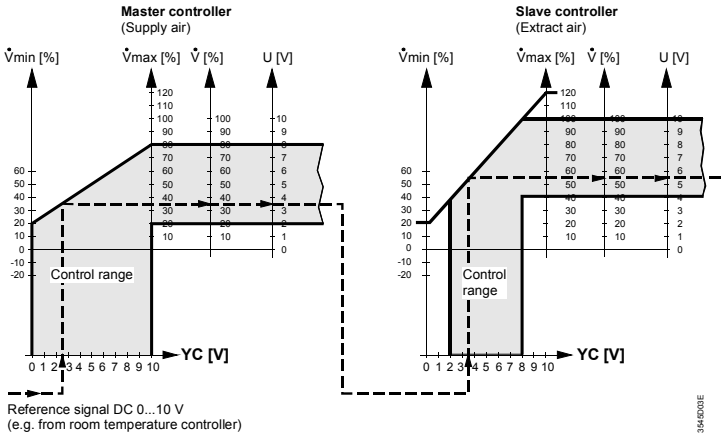
VAV differential pressure control 1 ≠ 1, with 20 % room underpressure

Master (supply air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Slave (extract air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 120 %, $\dot{V}_n$ = 1

Reference signal: Y20 = 2.5 V

Result: $\dot{V}_{master}$ = 35 %, $\dot{V}_{slave}$ = 55 %



Setting example 4

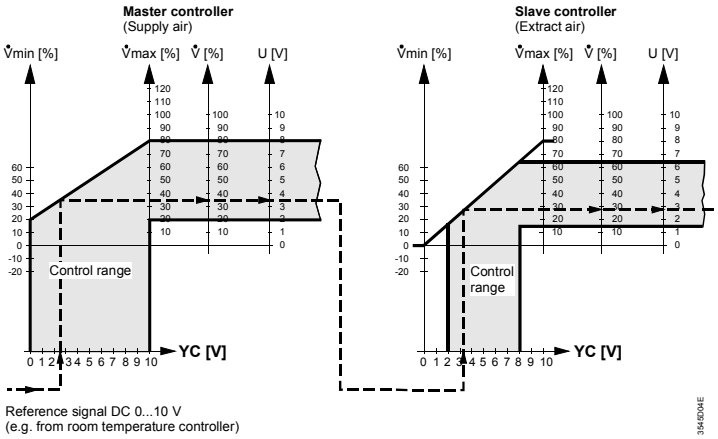
VAV relational control 1 ≠ 1,
with increasing room overpressure in proportion to the supply air volume

Master (supply air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Slave (extract air): $\dot{V}_{min}$ = 0 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Reference signal: Y20 = 2.5 V

Result: $\dot{V}_{master}$ = 35 %, $\dot{V}_{slave}$ = 28 %



Setting example 5

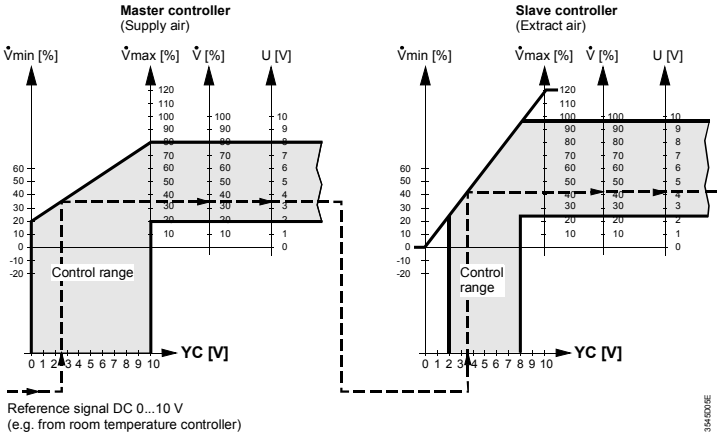
VAV relational control 1 ≠ 1,
with increasing room underpressure in proportion to the supply air volume

Master (supply air): $\dot{V}_{min}$ = 20 %, $\dot{V}_{max}$ = 80 %, $\dot{V}_n$ = 1

Slave (extract air): $\dot{V}_{min}$ = 0 %, $\dot{V}_{max}$ = 120 %, $\dot{V}_n$ = 1

Reference signal: Y20 = 2.5 V

Result: $\dot{V}_{master}$ = 35 %, $\dot{V}_{slave}$ = 42 %



Legend for setting examples 1 to 5

$\dot{V}$	Air volume
$\dot{V}_n$	Nominal air volume
$\dot{V}_{min}$	Minimal air volume
$\dot{V}_{max}$	Maximum air volume
$\dot{V}_{master}$	Air volume of the supply air controller (master)
$\dot{V}_{slave}$	Air volume of the extract air controller (slave)
Y	DC 0...10 V input signal (air volume setpoint)
UC	DC 0...10 V output signal (air volume actual value)

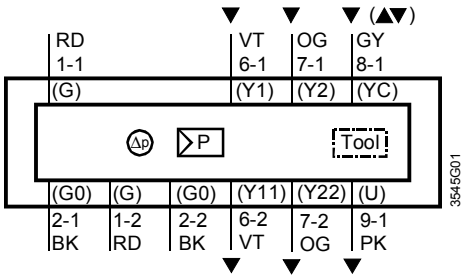
Actual value formula

$$\text{Actual value [\%]} = \frac{\text{Setpoint [\%]} \times (\dot{V}_{max} - \dot{V}_{min})\ \text{[\%]}}{100\ \text{[\%]}} + \dot{V}_{min}\ \text{[\%]}$$

$$\text{Actual value [V]} = \frac{\text{Setpoint [V]} \times (\dot{V}_{max} - \dot{V}_{min})\ \text{[V]}}{10\ \text{[V]}} + \dot{V}_{min}\ \text{[V]}$$

The VAV controller is supplied with a fixed, prefitted connecting cable. The connected units must be applied to the same G0.

Internal diagram
(applies to all types)



Legend

Connection cable 1 (color-coded and labeled):

Wire labelling	Colour of core	Landis & Staefa terminal code	Meaning
1	red (RD)	G	Live AC 24 V
2	black (BK)	G0	System neutral AC 24 V
6	violet (VT)	Y1	Positioning signal "Actuator rotary direction" (G0 switched), dependent on the setting of **AST10** or **ACS931**
7	orange (OG)	Y2	Positioning signal "Actuator rotary direction" (G0 switched), dependent on the setting of **AST10** or **ACS931**
8	gray (GY)	YC [1)]	Air volume reference signal DC 0 ... 10 V (setpoint) or communication signal with setting unit **AST10** or interface converter **AST11** connected.
9	pink (PK)	U	Air volume measuring signal DC 0 ... 10 V (actual value)

Connection cable 2 (color-coded and labeled):

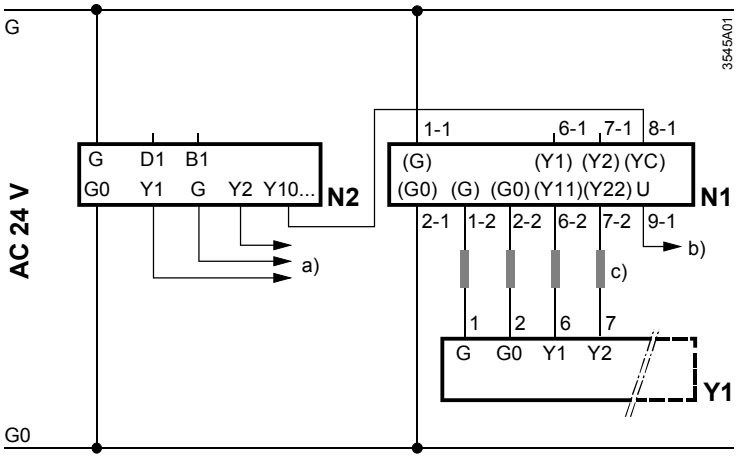
Wire labelling	Colour of core	Landis & Staefa terminal code	Meaning
1	red (RD)	G	Live AC 24 V
2	black (BK)	G0	System neutral AC 24 V
6	violet (VT)	Y11	Positioning signal "Actuator rotary direction" (G0 switched), dependent on the setting of **AST10** or **ACS931**
7	orange (OG)	Y22	Positioning signal "Actuator rotary direction" (G0 switched), dependent on the setting of **AST10** or **ACS931**

Tool = Service tool connecting socket (6-pole)

1) To guarantee proper functioning at YC, only one cable may be connected at a time – either the cable for the DC 0…10 V (set point) volume air flow reference signal or the cable for the communication signal!

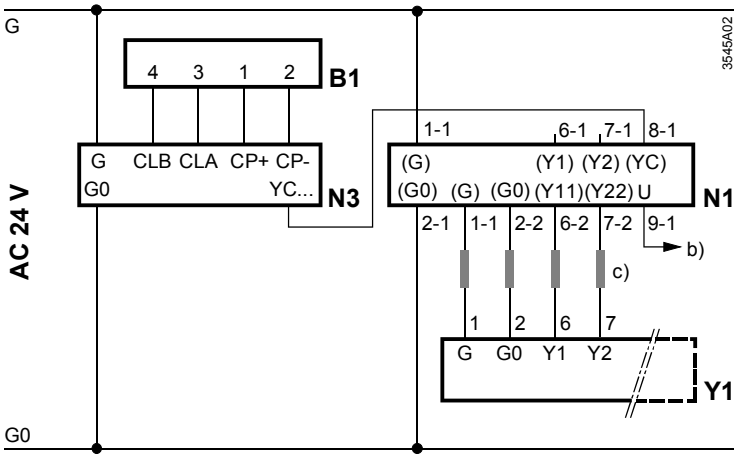
Connection diagram 1

Control loop without communication, for example, with actuator **GCA131.1E** and room temperature controller **RCU61…**



Connection diagram 2

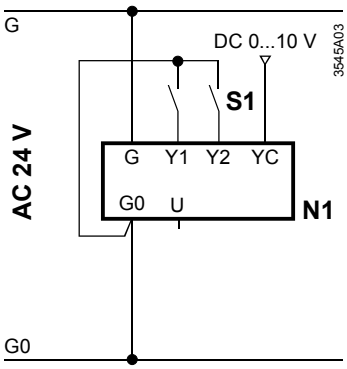
Control loop with communication, e.g. with **GCA131.1E** and room temperature controller DESIGO™ **RXC31.1**



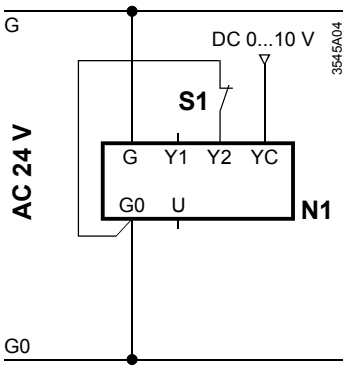
Connection diagrams 3a bis 3c

VAV supply air or extract air control (examples of input circuits)

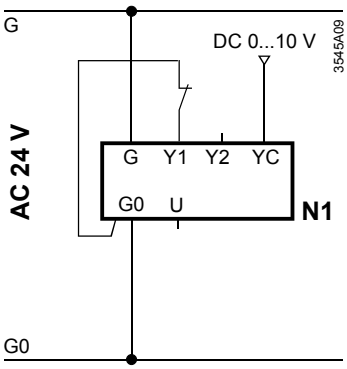
3a: modulating control $\dot{V}_{min}$ and $\dot{V}_{min}$



3b: modulating control between $\dot{V}_{max}$ and $\dot{V}_{min}$ and full closure



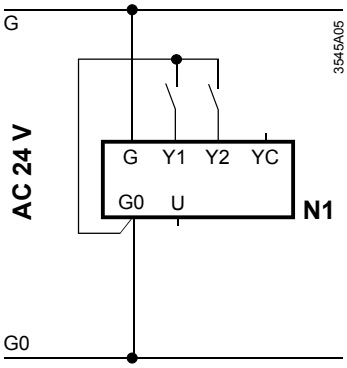
3c: modulating control between $\dot{V}_{min}$ and $\dot{V}_{max}$ and full opening



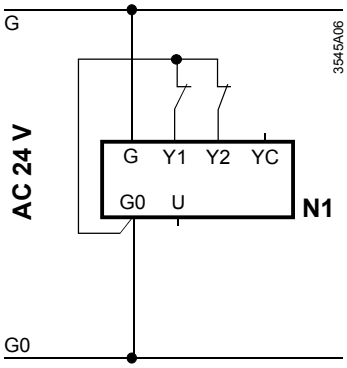
Connection diagrams 4a bis 4c

CAV supply air or extract air control (examples of input circuits)

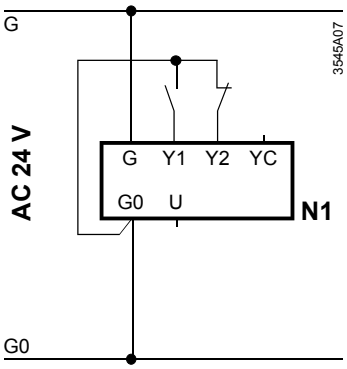
4a: control to $\dot{V}_{min}$ value



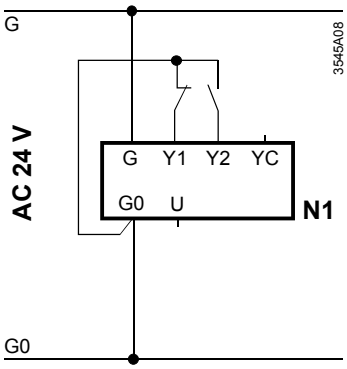
4b: control to $\dot{V}_{max}$ value



4c: complete closure



4d: complete opening



Legend for connecting diagrams 1 to 4

B1 Room unit **QAX32.1**
N1 **ASV181.1E/3** VAV controller
N2 Room temperature controller **RCU61.1**
N3 Room temperature controller DESIGO™ **RXC31.1**
S1 Window switch (window closed = switch open)
Y1 OpenAir™ air damper actuator, such as **GCA131.1E** (the G0 connetion is not necessary for actuators without spring return
a) To actuator for "Heating"
b) To the slave controller
c) Crimping sleeve connection (4 x AMP butt joints are enclosed with the device).

⚠

- The operating voltage on terminals G and G0 must comply with the requirements for safety extra-low voltage (SELV) as per EN 60 730.
- Use safety insulating transformers with double insulation in accordance with EN 60 742; the transformers must be suited for 100 % on-time.
- The outputs Y11, Y22, G and G0 are not short-circuit-proof.

Dimensions (All dimensions in mm)