SIEMENS

Infrastructure & Cities





OpenAir™
VAV Compact Controllers G..B181.1E/3
VAV Modular Controller ASV181.1E/3

Technical Basics

CE1P3544en
2023-28-11

Smart Infrastructure

Issued by
Siemens Switzerland AG
Smart Infrastructure
Global Headquarters
Theilerstrasse 1a
6300 Zug
Switzerland
Tel. +41 41-724 24 24
www.siemens.com/buildingtechnologies

© Siemens Switzerland AG, 2011
Technical specifications and availability subject to change without notice.

Table of contents

1 Introduction 4
1.1 Revision history 4
1.2 Before you start 4
1.3 Objectives of this basic documentation 4
1.4 References 5
2 Device 6
2.1 Type summary 6
2.2 Design and device parts 9
2.3 Dimensions 10
2.4 Human-machine interface 10
2.5 Internal diagrams 11
2.6 Measuring principle 12
3 Application 13
3.1 Fields of application 13
3.2 Equipment combinations 13
3.3 Application examples 14
4 Electrical and mechanical installation 18
4.1 Mechanical installation / mounting 18
4.2 Electrical installation / cabling 19
5 Parameterization and operating modes 22
5.1 Settings and user interaction 22
5.2 Operating modes 23
5.4 Setting examples 28
6 Commissioning 34
6.1 Documentation of engineering and commissioning 34
6.2 Commissioning 34
7 Safety and EMC optimization 35
7.1 Safety notes 35
7.2 Device-specific regulations 36
7.3 Notes on EMC optimization 37
8 Technical data 38
9 Datapoints and function description 40
9.1 Device Parameters (ACS931 / ACS941 / AST20) 40
9.2 Parameters and function description 41
9.3 Communication object priorities 43
10 Environmental compatibility and disposal 44

1 Introduction

1.1 Revision history

Version	Date	Changes	Section	Pages
1.3	11/04/2023	Update for Series H Implementation of communication object priorities	9.3 Communication object priorities	43
1.2	26/10/2021	Adjustments regarding AST22		
1.1	26/02/2016	EU and RCM Conformity, European Directive 2012/19/EU	8 Technical data, 10 Environmental compatibility and disposal	38 41
1.0	12/12/2011	Newly created for Series E		

1.2 Before you start

1.2.1 Copyright

This document may be duplicated and distributed only with the express permission of Siemens and may be passed only to authorized persons or companies with the required technical knowledge.

1.2.2 Quality assurance

These documents were prepared with great care.

- The contents of all documents are checked at regular intervals.
- Any corrections necessary are included in subsequent versions.
- Documents are automatically amended as a consequence of modifications and corrections to the products described.

Please make sure that you are aware of the latest document revision date.

1.2.3 Document use / request to the reader

Before using our products, it is important that you read the documents supplied with or ordered at the same time as the products (equipment, applications, tools etc.) carefully and in full.

We assume that persons using our products and documents are authorized and trained appropriately and have the technical knowledge required to use our products as intended.

Siemens assumes no liability to the extent allowed under the law for any losses resulting from a failure to comply with the aforementioned points or for the improper compliance of the same.

1.3 Objectives of this basic documentation

This basic documentation covers the VAV compact controllers GDB181.1E/3 and GLB181.1E/3 as well as the VAV modular controller ASV181.1E/3. These devices are designed for controlling variable or constant air volume flows.

This document describes the devices and their application, mounting, engineering/commissioning, and decommissioning. A references section lists technical data and parameters.

1.4 References

[1] G..B181.1E/3 – Datasheet for VAV compact controller (N3544)
[2] G..B181.1E/3 – Mounting instruction for VAV compact controller (M3544)
[3] ASV181.1E/3 – Datasheet VAV modular controller (N3545)
[4] ASV 181.1E/3 – Mounting instruction VAV modular controller (M3545)
[5] AST20 – Handheld tool for VAV compact controller (A6V10631836)
[6] AST22 – Interface converter (A6V11236956)
[7] ACS931 – PC-Software for OEM (N5853)
[8] ACS941 – PC-Software for Service (N5854)

2 Device

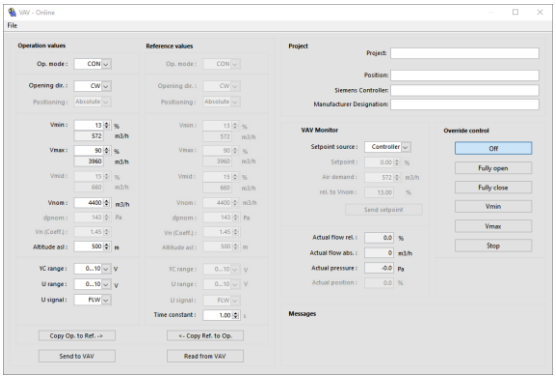
2.1 Type summary

2.1.1 Device variants, tools, and accessories

VAV compact and modular controllers

GDB181.1E/3 (5 Nm) GLB181.1E/3 (10 Nm)	ASV181.1E/3
	

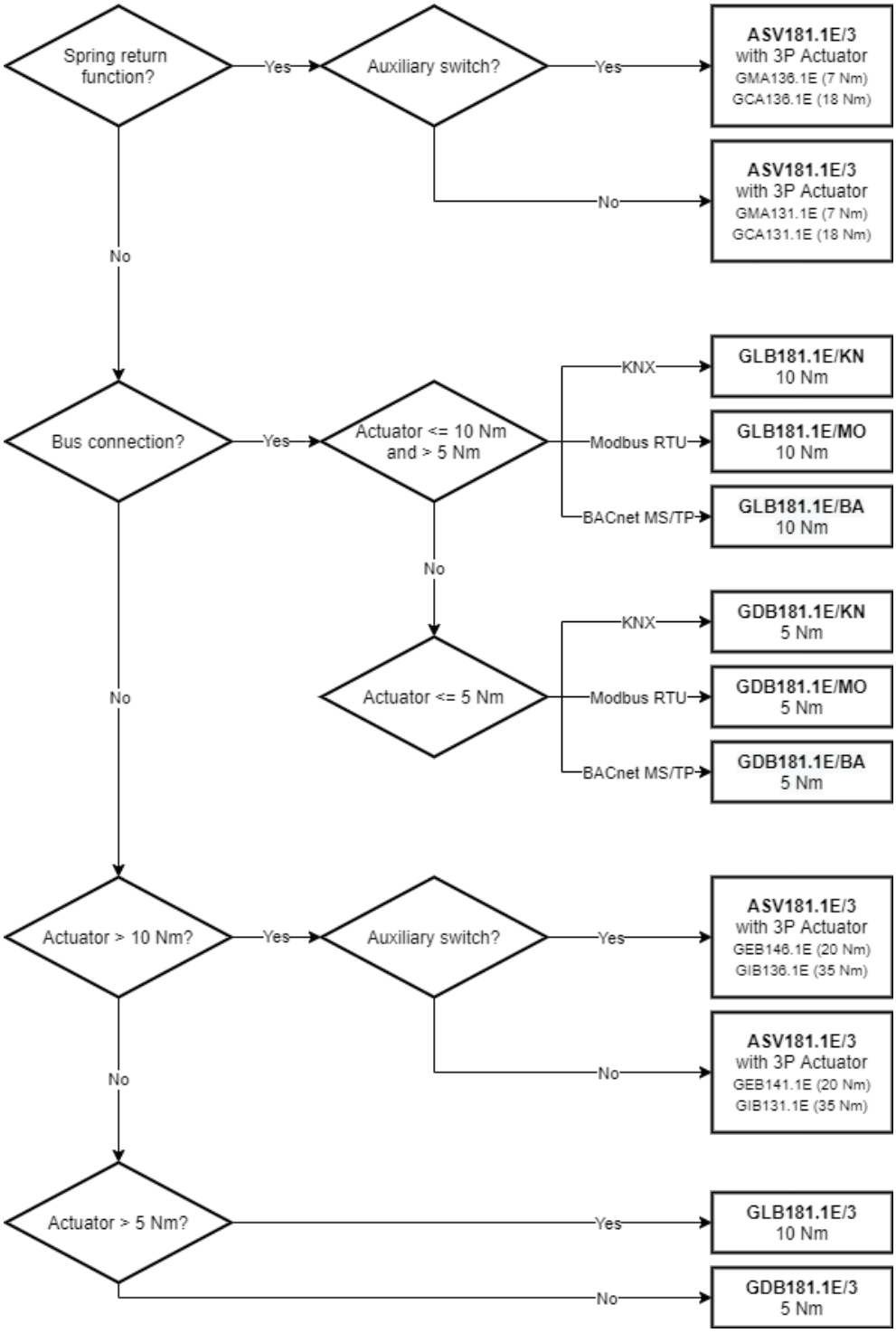
Tools for commissioning and service

AST20	ACS931 / ACS941
	
The handheld tool AST20 can be used for status monitoring, VAV parameter setting, and bus configuration setting. It supports a Service and an OEM access level with PIN code protection.	The PC software for service ACS941 can be used for setting and reading a certain set of device parameters (values set by OEM and current configuration, and actual values). The PC software for OEMs ACS931 can be used for full factory configuration in the and is distributed exclusively to VAV box OEMs. For connecting to a PC, an interface converter AST22 is required.
Datasheet: A6V10631836	Datasheet ACS931: N5853 / Datasheet ACS941: N5854 Datasheet AST22: A6V11236956

Accessories

For information regarding accessories and spare parts for VAV compact controllers, please refer to datasheet N4698.

2.1.2 Selection guide for all types



2.1.3 Version summary

Each VAV Compact Controller has a product series identification which can be found in the top right corner of the product label. The product series gives information about significant hardware or firmware changes.

Version identification

Version	Series E	Series F and later
Identification		

Change history

Version	Production start	Major changes
Series E	03/2012	- DC 0/2 …10 V, 3 position control or STP control - New differential pressure sensor - Feedback signal selectable (volume flow or damper position) - Optional adaptive damper position feedback (based on actual damper opening range) - HMI with multicolor LED
Series F	01/2016	- Full closure override control in 2-10V operation - Support for DMC (data matrix code) based workflows
Series G	08/2020	- Improved device data interface for OEM programming
Series H	10/2023	- Update of priorities for communication objects due to firmware update to version 7.17

2.2 Design and device parts

2.2.1 Design

The VAV compact controllers consist of a differential pressure sensor, actuator and digitally configurable control electronics. They are intended for mounting on damper shafts of a minimum length of 30 mm. They consist of base and 2-sectional housing.

Components contained in the **base**:

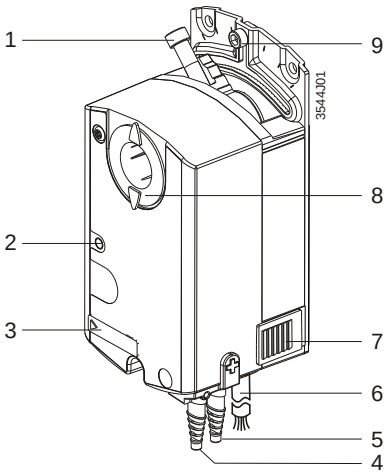
- Steel base plate with damper drive shaft fixing for different drive shaft diameters / cross-sectional areas (cf. section **2.3**) and angular rotation limiter,
- maintenance-free, low-noise gear train,
- magnetic hysteresis clutch with practically contact-free force transmission; this means that the actuator is locking- and overload-proof.

Components contained in the **housing** (Note: Housing cover must not be removed):

- Controller electronics,
- differential pressure sensor, and
- synchronous motor for the damper actuator.

2.2.2 Main device parts

G..B181.1E/3

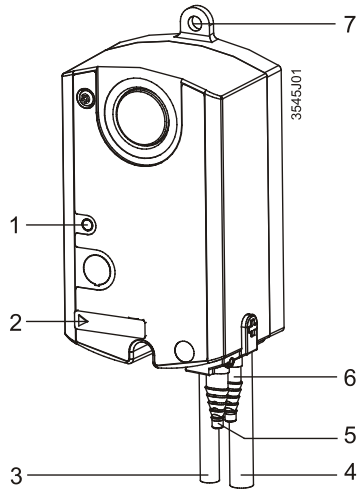


1 Shaft attachment screw
2 LED
3 Configuration and maintenance interface (below cover)
4 Connection nozzle for measuring differential pressure in the VAV box
5 Connection nozzle for measuring differential pressure in the VAV box ("+": Side with higher pressure)
6 6-core connecting cable (power and communications)
7 Disengagement of gear train
8 Rotation angle display
9 Rotation angle check screw

Gear train disengagement

Manual control of the air dampers is possible by gear train disengagement (7) when the VAV compact controller is **disconnected from the power supply**.

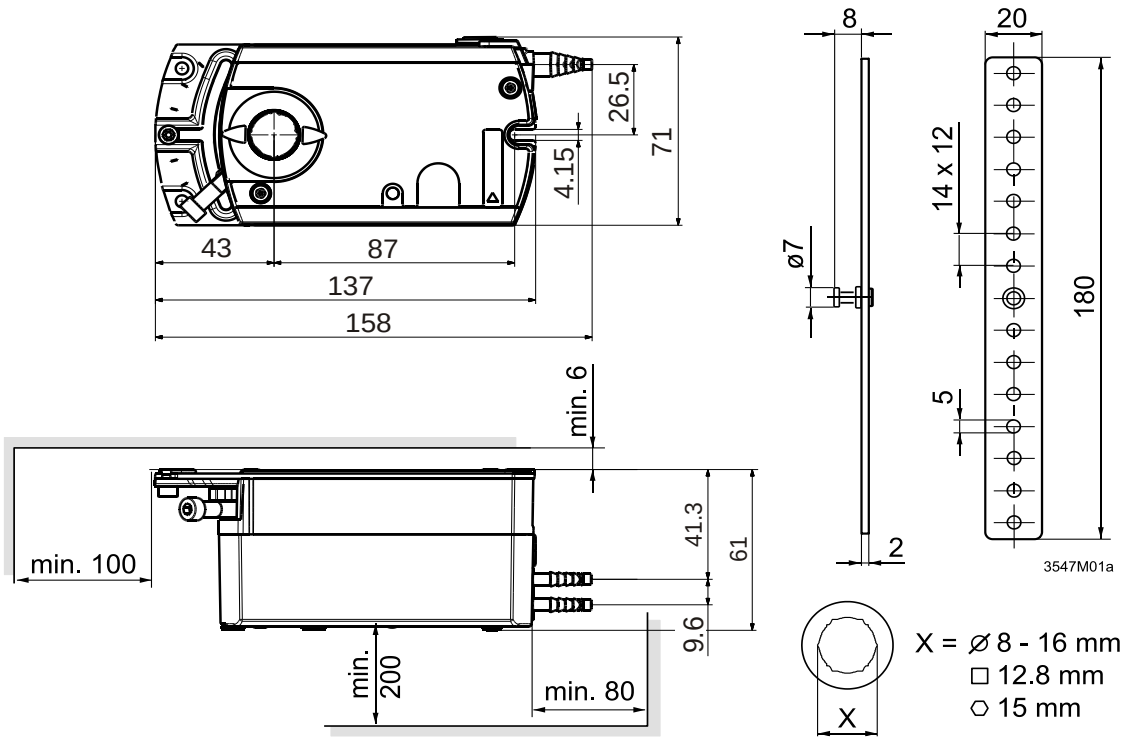
ASV181.1E/3



1 LED
2 Configuration and maintenance interface (below cover)
3 4- core connecting cable for OpenAir 3P air damper actuator
4 6-core connecting cable (power and communications)
5 Connection nozzle for measuring differential pressure in the VAV box
6 Connection nozzle for measuring differential pressure in the VAV box ("+": Side with higher pressure)
7 Beltline hook

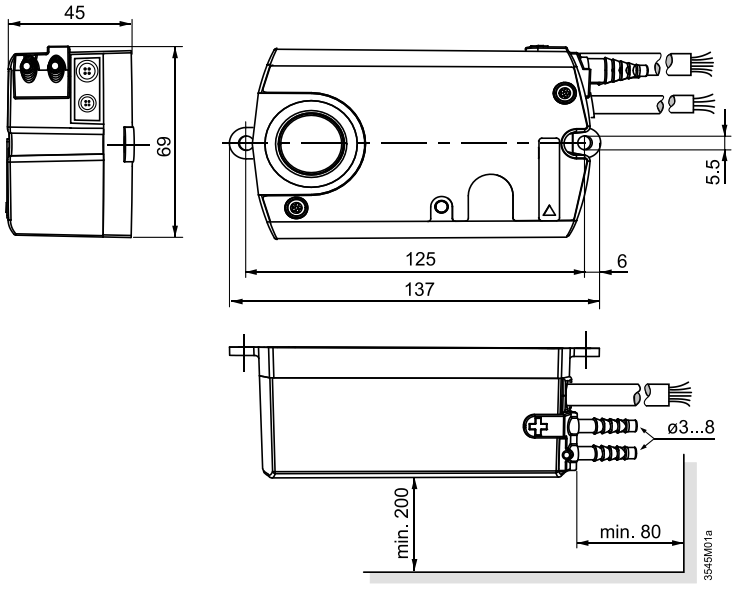
2.3 Dimensions

G..B181.1E/3



Measures in mm

ASV181.1E/3



Measures in mm

2.4 Human-machine interface

The multicolor LED states are described below.

LED state display

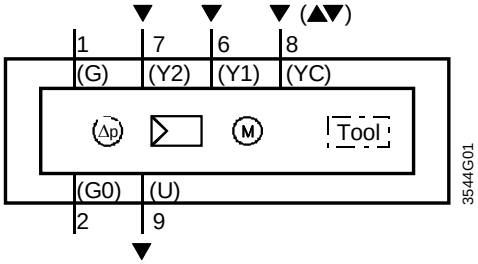
LED display	Description
LED dark	No operating voltage
LED green	Faultless operation
LED flashes red	Connection tubes for sensor interchanged
LED red	Differential pressure sensor fault

2.5 Internal diagrams

The VAV compact controllers are supplied with one prewired 6-core power supply and communication cable. The VAV modular controller is supplied with one prewired 6-core power supply and communication cable and one prewired 4-core connection cable for OpenAir 3P damper actuators.

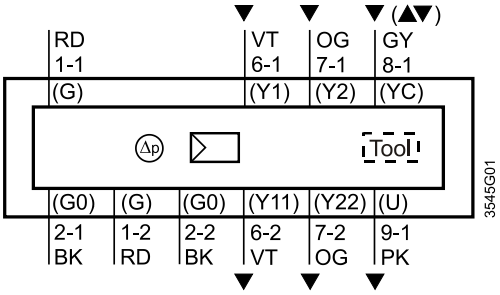
All interconnected devices must be connected to the same G0.

G..B181.1E/3



Tool = Configuration and maintenance interface
(Series A – D: 6-pin;
Series E or later: 7-pin)

ASV181.1E/3



Legend (G..B181.1E/3, ASV181.1E/3)

Core designation	Core color	Terminal code	Description
1	red (RD)	G	System potential AC 24 V
2	black (BK)	G0	System neutral AC 24 V
6	violet (VT)	Y1	Positioning signal "rotation direction" (G0 switched) dependent on the setting of direction
7	orange (OG)	Y2	
8	grey (GY)	YC[1]	Air volume flow reference signal DC 0/2...10 V (setpoint) or communication signal
9	pink (PK)	U	Air volume flow measuring DC 0/2...10 V (actual value)

Additional legend (ASV181.1E/3)

Connecting cable 2 (color-coded and labeled):

Core designation	Core color	Terminal code	Description
1	red (RD)	G	System potential AC 24 V
2	black (BK)	G0	System neutral AC 24 V
6	violet (VT)	Y11	Positioning signal "rotation direction" (G0 switched)
7	orange (OG)	Y22	

[1] To ensure the functions at YC, only one cable may be connected at the time, either the cable for the air volume flow reference signal DC 0/2...10 V (setpoint) or the cable for the communication signal

2.6 Measuring principle

A measuring device for acquiring the differential pressure – usually a measuring cross, measuring orifice or Venturi tube in the airflow – represents the basis for air volume flow measurement.

Differential pressure sensor

The air volume flow is measured indirectly with a differential pressure sensor. Since the measured value is the differential pressure ∆p, the air flow is derived from this value using the VAV box characteristic. Accordingly, the VAV box OEM has to provide the combination of Δpnom and Vnom, out of which the air volume flow in m^3/h or l/s can be calculated.

The air volume flow value (relative or absolute) can be transmitted over the bus together with the actual value of the damper position (in %) to be used by a supervisory controller or for management purposes. The differential pressure sensor operates long-term stable and without recalibration.

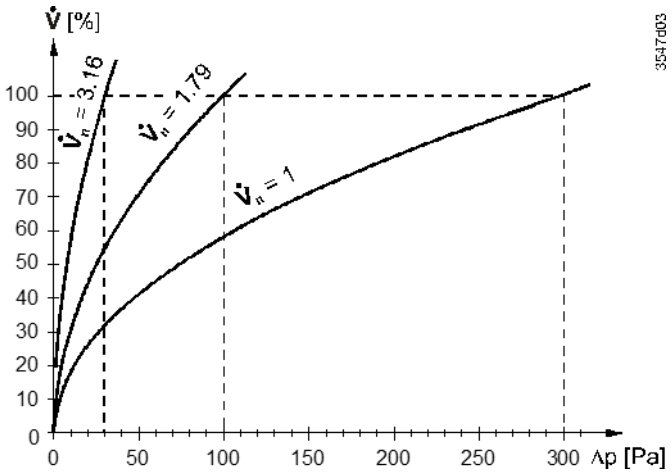
Note

In critical cases material compatibility tests should be made while considering harmful substances and concentrations.

Setting the characteristic value Vn

The parameter Vn is used to adjust the operating range of the differential pressure sensor (0…300 Pa) to the actual VAV box nominal pressure Δpnom at the factory. The effect of Vn is illustrated in the diagram below.

Effect of Vn



Calculation of Vn (Δpnom = nominal differential pressure)

$$V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}}$$

Calculation example

Assume that a VAV box is designed for a nominal pressure of Δpnom = 120 Pa. Then Vn must be set to 1.58:

$$V_n = \sqrt{\frac{300\ Pa}{120\ Pa}} = 1.58$$

3 Application

3.1 Fields of application

Application

VAV compact controllers are primarily used for controlling a variable or constant air volume flow.

Application fields:

- Supply air control
- Extract air control
- Supply/extract cascade control with
  - Ratio control 1:1
  - Ratio control (positive/negative pressure)
  - Differential control (positive/negative pressure)

Note

VAV compact controllers are not suitable for environments where the air is saturated with sticky or fatty particles or contain aggressive substances.

In critical cases material compatibility tests should be made while considering harmful substances and concentrations.

3.2 Equipment combinations

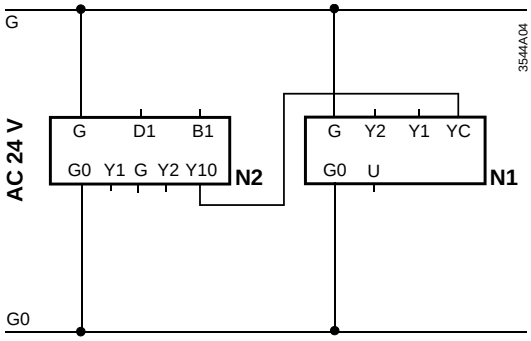
Device	Type	Datasheet
Tools for configuration and service		
Handheld tool	AST20	A6V10631836
Interface converter	AST22	A6V11236956
PC software for OEMs	ACS931 v6.0 or later	5853
PC software for service	ACS941 v3.0 or later	5854

3.3 Application examples

3.3.1 Operating examples

VAV

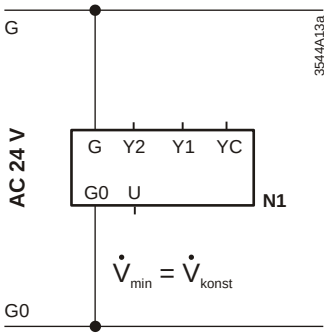
Supply / extract air control in operating mode “con”



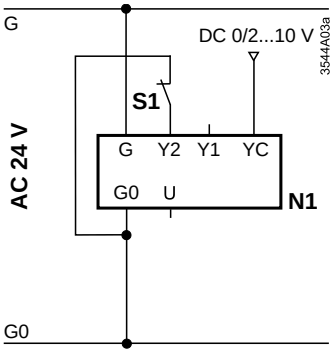
N1 G..B181.1E/3
N2 Supervisory controller

CAV

Supply / extract air control in operating mode “con”



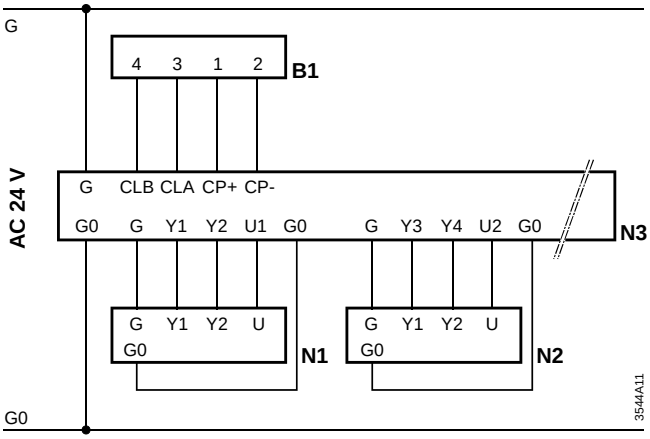
Complete shutoff in operating mode “con”



N1 G..B181.1E/3
S1 Window switch (Window closed – switch open)

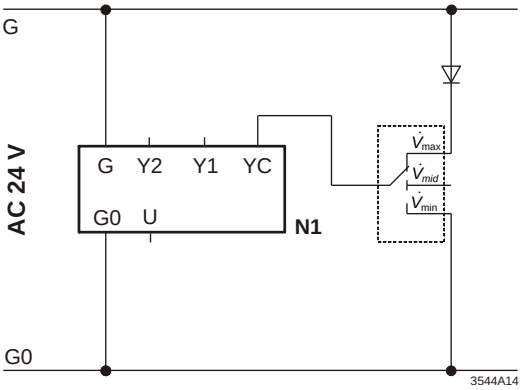
Operating mode “3P”

Supply / extract air control



N1 G..B181.1E/3 –supply air–
N2 G..B181.1E/3 –extract air–
N3 Room temp. controller
B1 Room unit

Operating mode “STP”



N1 G..B181.1E/3

3.3.2 Connection diagrams

Legend to the connection diagrams 1 through 4

N1 **G..B181.1E/3** or **ASV181.1E/3**

N2 Room temperature controller

S1 Window switch (window closed = contact open)

Y1 OpenAir™ actuator, e.g. **GCA131.1E** (for non-spring return actuators, connection G0 is not used)

a) To actuator for "Heating"

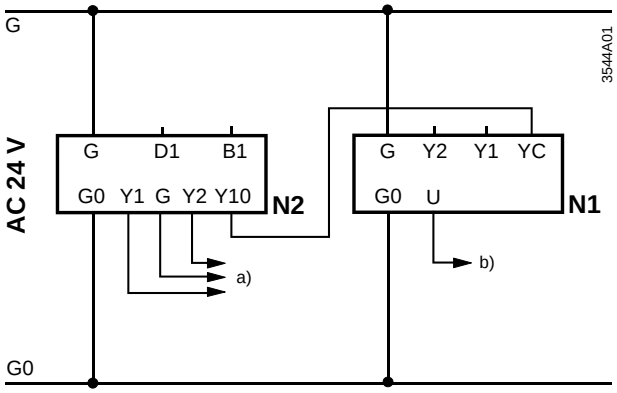
b) To slave controller

c) Crimping sleeve connection (4 x AMP butt joints are enclosed with the unit)

- The operating voltage fed to terminals G and G0 must comply with the requirements for SELV or PELV
- Use safety isolating transformers with double insulation conforming to EN 61558; they must be suited for 100 % on time

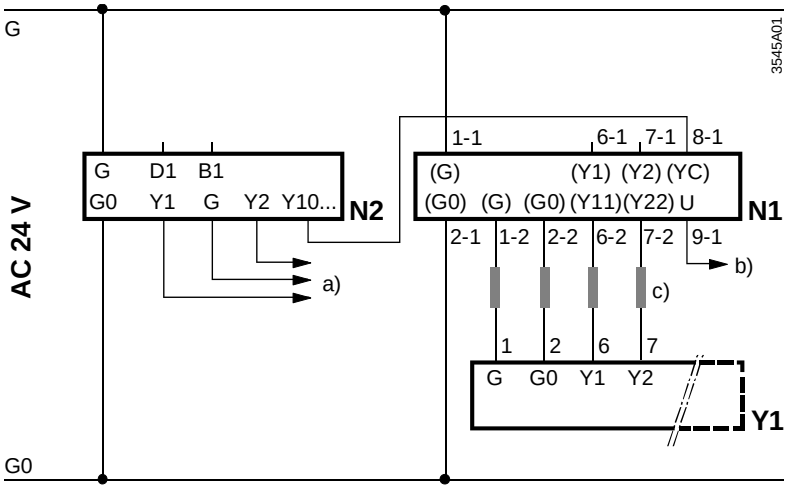
Connection diagram 1 (G..B181.1E/3)

Control loop without communication, e.g. with **G..B181.1E/3** “con” mode and room temperature controller.



Connection diagram 2 (ASV181.1E/3)

Control loop without communication, e.g. with **GCA131.1E** and room temperature controller.



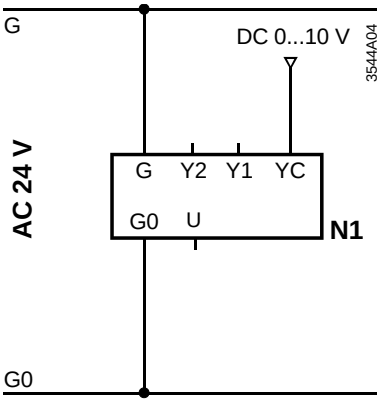
Note

Outputs Y11, Y22, G and G0 are not short-circuit-proof!

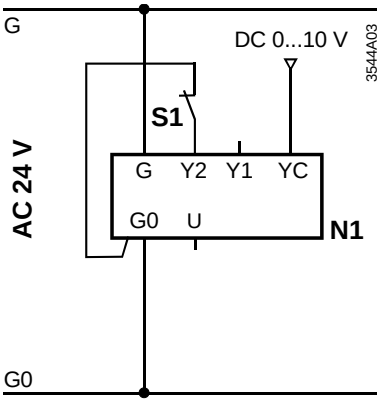
Connection diagrams 3a through 3c

VAV supply or extract air control (examples)

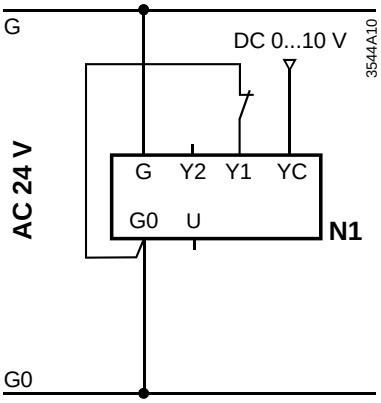
3a: Modulating control between $\dot{V}_{max}$ and $\dot{V}_{min}$



3b: Modulating control $\dot{V}_{max}$ and $\dot{V}_{min}$ and complete shutoff



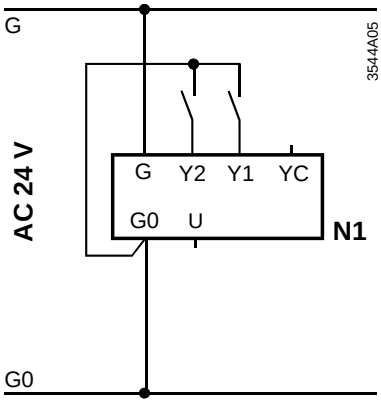
3c: Modulating control between $\dot{V}_{max}$ and $\dot{V}_{min}$ and fully open



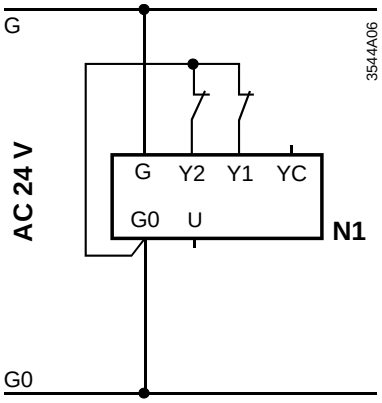
Connection diagrams 4a through 4d

CAV supply or extract air control (examples)

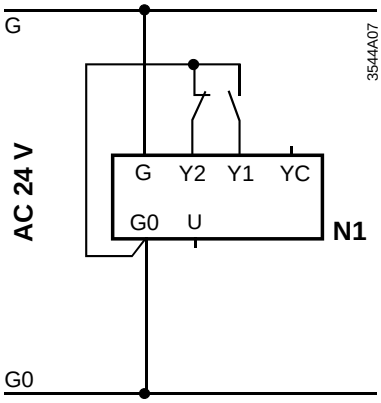
4a: Control to $\dot{V}_{min}$ value



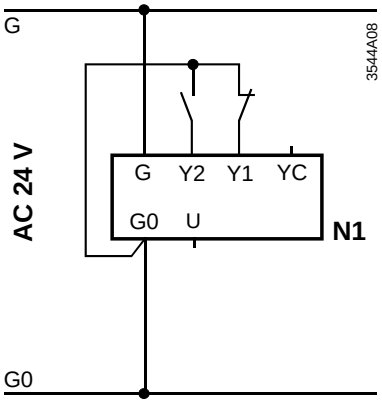
4b: Control to $\dot{V}_{max}$ value



4c: Complete shutoff

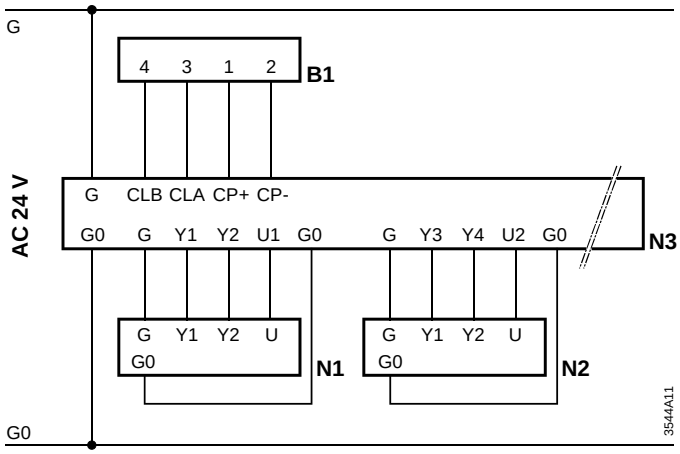


4d: Fully open



Connection diagram 5

Supply / extract air control, e.g. with **G..B181.1E/3** “3P” mode and room temperature controller.



Legend to connection diagram 5

N1 **G..B181.1E/3** – supply air –
N2 **G..B181.1E/3** – extract air –
N3 Room temperature controller
B1 Room unit

4 Electrical and mechanical installation

4.1 Mechanical installation / mounting

Mounting and mounting limitations

For mounting and limitations on mounting (location / position), consulting the mounting instruction M3544 ([2]) or M3545 ([4]) is mandatory.

Environmental conditions

The permissible ambient temperature and ambient humidity must be observed.

Manual control

The actuator may only be manually operated when **separated from power supply**.

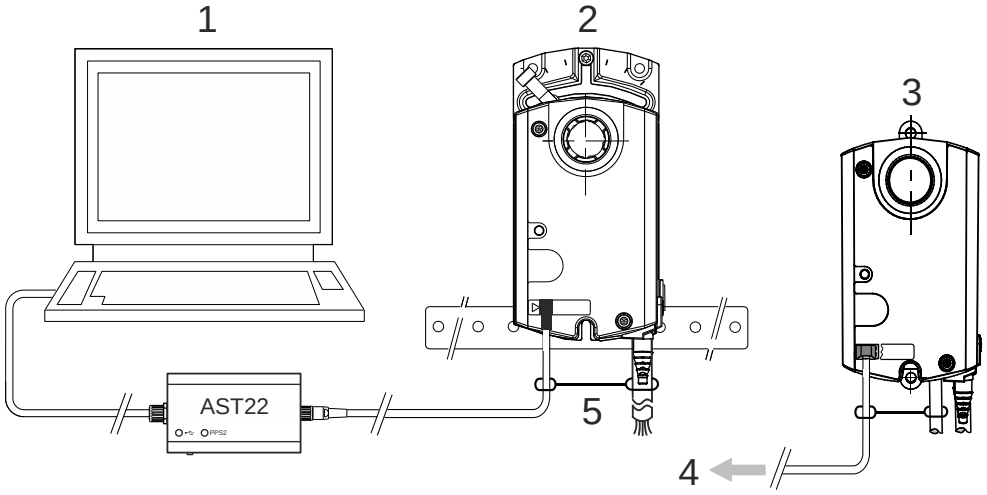
Mechanical limitation of angular rotation

If required, the angular rotation can be set by appropriate adjustment of the adjusting screw.

Strain release strip

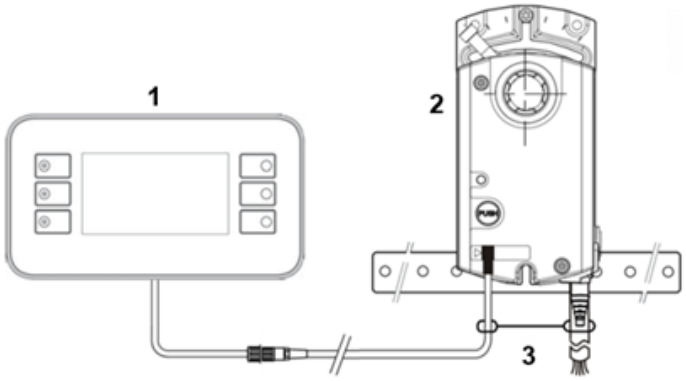
When using the connecting cable with **the 6- or 7-pin plug**, attach the strain relief strip at the cable to the VAV compact and modular controllers as shown in the following illustration.

Connection to PC with AST22



1 PC (with ACS931 or ACS941)
2 G..B181.1E/3
3 ASV181.1E/3
4 Connection to AST22
5 Strain relief strip

Connection to AST20



1 AST20
2 G..B181.1E/3
3 Strain relief strip

4.2 Electrical installation / cabling

Introduction

Prior to wiring, observe all information in the following sections:

- „Safety notes" in section **7.1**
- „Device-specific regulation" in section **7.2**.
- „Notes on EMC optimization" in section **7.3**.

4.2.1 Power supply cabling

Permissible cable lengths and cross-sectional areas

The permissible cable lengths and cross-sectional areas depend on the VAV compact controllers' current draw and the voltage drop on the connecting lines to the actuators. The necessary cable lengths can be determined from the L/P chart (next page) or with the help of the formulas. Cf. also technical data in section **8**.

Note

When determining the cable length and the cross-sectional area, it is to ensure that the permissible tolerances of the VAV compact controllers' operating voltage are adhered to, in addition to the permissible voltage drop on the power supply and signal lines (table below).

Permissible voltage drop

The cables are to be sized depending on the type of VAV compact controller used and based on the following data:

Type	Operating voltage	Line	Max. permissible voltage drop
G..B181.1E/3, ASV181.1E/3	AC 24 V	G0, G	each 4 % (tot. 8 %)

Note on G0 line (G..B181.1E/3 and ASV181.1E/3)

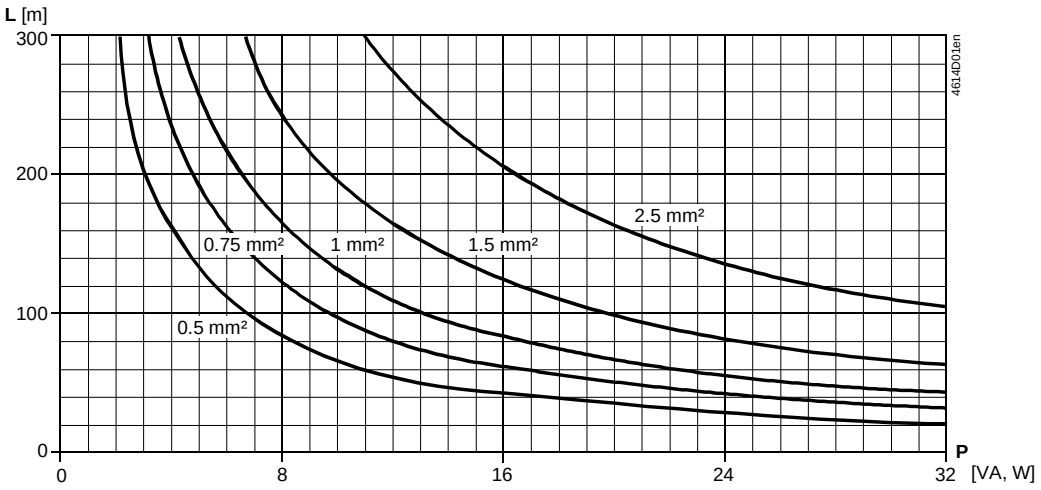
The following criteria are to be considered:

- For modulating control:
  The permissible positioning signal error, caused by the voltage drop on the G0 line, must not exceed 1 %
- The voltage drop on the G0 line, caused by surges in the actuator's rectifier circuit, must not exceed 2 Vpp
- If the G0 line is not correctly sized, actuator load changes can produce oscillations caused by changes in the DC voltage drop.
- The supply voltage loss at AC 24 V must not exceed 8 % (4 % over the G0 line)
- **The DC voltage drop on the G0 line** is caused by:
  - Unsymmetry in the internal actuator power supply (> DC 8 mA)
  - Positioning signal current DC 0.1 mA (from Y = DC 0…10 V) and
  - Output signal current DC 1 mA (from U = DC 0…10 V).

The DC voltage drop can be ignored for the following considerations.

L/P chart for AC 24 V

The chart below applies to AC 24 V operating voltage and shows the permissible cable length **L** as a function of power **P**, and the cross-sectional areas as a parameter.

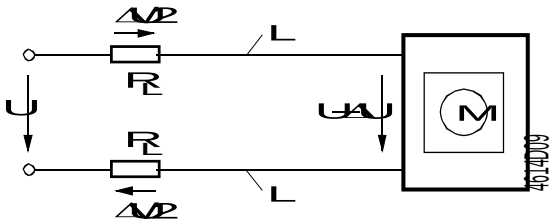


Note on chart

The values in [VA, W] on the P-abscissa are allocated to the permissible voltage drops (ΔU/2U = 4 %) on line length L as per the above table and the basic diagram.

P is the decisive power consumption of all VAV compact controllers connected in parallel.

Basic diagram: Voltage drop on the supply lines



Formulas for cable length

The following formulas can be used to calculate the maximum cable lengths.

Operating voltage	Permissible voltage drop per line	Formula for cable length
AC 24 V	4 % of AC 24 V	$L = \frac{1313 \bullet A}{P}$ [m]
	1 % of DC 10 V	$L = \frac{5.47 \bullet A}{I(DC)}$ [m]

A Cross-sectional area in [mm²]
L Permissible cable length in [m]
P Power consumption in [VA] or [W];
refer to the VAV compact controllers' type field
I(DC) DC current portion on G0 line in [A]

Example: Power consumption and permissible voltage drop (1 VAV compact controller)

Operating voltage	Power consumption	Perm. voltage drop for line... 1 (G), 2 (G0)
AC 24 V	3 VA	4 % of AC 24 V

Example: Parallel connection of 4 VAV compact controllers

Determine the cable lengths for 4 VAV compact controllers operating on AC 24 V. Decisive for sizing the cable are only the AC currents on lines 1 (G) and 2 (G0). Maximum permissible voltage drop = **4 % per line**.

- Consumption = 4 x 3 VA = 12 VA
- Line current = 4 x 0.125 A = 0.5 A

Permissible single cable length for G and G0:

- 164 m with a cross-sectional area of 1.5 mm^2
- 274 m with a cross-sectional area of 2.5 mm^2

5 Parameterization and operating modes

5.1 Settings and user interaction

The VAV compact controllers can be parameterized with configuration tools (cf. “equipment combinations”)[2].

Settings for setpoint signal YC

Parameter	Setting	Description	Siemens factory setting
YC	0…10 V	Setpoint for air volume flow	0…10 V (operating mode “con”)
	2…10 V		

Settings for actual value signal U

Parameter	Setting	Description	Siemens factory setting
U	FLW	Actual value of air volume flow (measurement value)	FLW
	POS [3]	Position display of air damper	
	0…10 V		0…10 V
	2…10 V		
	0.05…5 s (Resolution 0.01 s)	Time constant actual value U	1 s

Settings for adaptive positioning (for special opening ranges)

Parameter	Setting	Description	Siemens factory setting
ADP [4]	Off	Default operating mode for position display of air damper (mapping 0°…90° → 0…100 %)	Off
	On	Adaptive operating mode for position display of air damper (mapping e.g. 0°…60° → 0…100 %)	

Setting elevation for sensor accuracy

Parameter	Setting	Description	Siemens factory setting
Elevation asl	0…5000 m (Resolution 500 m)	Elevation asl to increase pressure sensor accuracy	500 m

LED state display

LED state	Description
LED dark	No operating voltage
LED green	Faultless operation
LED flashes red	Connection tubes for sensor interchanged
LED red	Differential pressure sensor fault

[2] For connections at the configuration and maintenance interface please consider that voltages >10 V at YC can’t be processed.

[3] Not applicable for ASV181.1E/3

[4] Not applicable for ASV181.1E/3

5.2 Operating modes

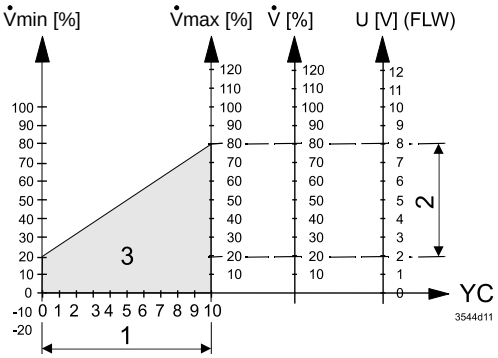
Operating mode “con”

The following parameters must be set or checked in operating mode “con”:

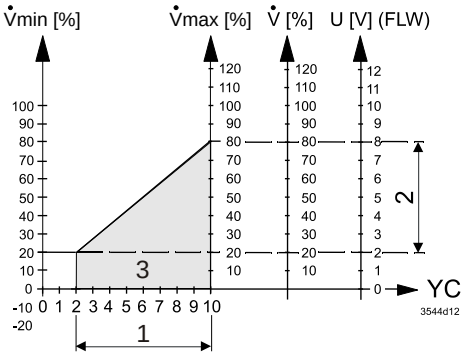
Parameter	Setting	Description	Siemens factory setting
Type	con	VAV or CAV mode	con
Setpoint YC	0…10 V 2…10 V	Air volume flow reference signal (setpoint)	0…10 V
$\dot{V}_n$	1.00…3.16	Characteristic value for nominal air volume flow, set by manufacturer (OEM)	1.00
$\dot{V}_{max}$	20…120 %	Maximum air volume flow	100 %
$\dot{V}_{min}$	-20…100 %	Minimum air volume flow	0 %
Dir	**r** or **L**	Opening direction of air damper **r** = Clockwise (CW) **L** = Counterclockwise (CCW)	**r**

Variable air volume (VAV) control

The VAV compact controllers operate in VAV mode provided a DC 0…10 V or DC 2…10 V signal is fed into the input YC. The setpoint signal controls the operating range $\dot{V}_{min}$ … $\dot{V}_{max}$.



YC 0…10 V
1 Reference signal
2 Output signal
3 Control range



YC 2…10 V
1 Reference signal
2 Output signal
3 Control range

Forced control in VAV mode

Using the Y1 and Y2 control signals, the damper of the air volume controller can be driven either to the fully open or fully closed position.

VAV operating mode (Type “con”)				
YC	DC 0/2…10 V			
Y1	open	G0	G0	open
Y2	open	open	G0	G0
Action	VAV control with DC 0/2…10 V setpoint compensation	Dir **r** → rotation CW Dir **L** → rotation CCW **“Fully open“**	VAV control with DC 0/2…10 V setpoint compensation	Dir **r** → rotation CCW Dir **L** → rotation CW **“Fully closed“**

Note

Setting $\dot{V}_{min}$ ≤0 % and YC = 0 V drives the actuator to position “fully closed”.

Constant air volume (CAV) control

VAV compact controllers operate in CAV mode if input YC is **open**. $\dot{V}_{min}$ or $\dot{V}_{max}$ control can be accomplished with control signals Y1 and Y2.

Forced control in CAV mode

If inputs Y1 and Y2 are wired appropriately, different states can be reached according to the following table:

CAV operating mode (Type “con”)				
YC	open			
Y1	open	G0	G0	open
Y2	open	open	G0	G0
Action	$\dot{V}_{min}$ control	Dir **r** → rotation CW Dir **L** → rotation CCW **“Fully open“**	$\dot{V}_{max}$ control	Dir **r** → rotation CCW Dir **L** → rotation CW **“Fully closed“**

Notes

CAV mode is also possible when preselecting a constant setpoint via input YC. Setting $\dot{V}_{min} \leq 0$ drives the actuator to position “fully closed”.

Operating mode “3P”

To use VAV compact controllers as differential pressure sensor for air volume flow measurement with a 3-position actuator, the operating mode parameter must be set to “3P”.

Parameter setting

In operating mode “3P”, the following parameters must be set or checked:

Parameter	**Setting**	**Description**	**Siemens factory setting**
Type	3P	3P mode	con
$\dot{V}_n$	1…3.16	Characteristic value for nominal air volume flow, set by manufacturer (OEM)	1
Dir	**r** or **L**	Opening direction of air damper **r** = Clockwise (CW) **L** = Counterclockwise (CCW)	**r**

In operating mode “3P”, $\dot{V}_{min}$ and $\dot{V}_{max}$ are of no relevance since air volume flow control in this mode is ensured by the higher level room controller (typically cascade of room temperature and air volume flow). In this operating mode, air volume flow control of the VAV compact controllers is deactivated.

The air damper opening direction is determined by the connection of signal inputs Y1 (core 6, violet) and Y2 (core 7, orange).

Differential pressure sensor with 3-position actuator (Type “3P”)				
YC	N/A			
Y1	open	G0	G0	open
Y2	open	open	G0	G0
Action	Damper holds position	Dir **r** → rotation CW Dir **L** → rotation CCW **Damper opens**	Dir **r** → rotation CCW Dir **L** → rotation CW **Damper closes**	Dir **r** → rotation CCW Dir **L** → rotation CW **Damper closes**

Operating mode “STP”

CAV step mode: CLOSE / $\dot{V}_{min}$ / $\dot{V}_{mid}$ / $\dot{V}_{max}$ / OPEN

CAV step mode (Type “STP”)				
YC	<1 V → $\dot{V}_{min}$			
	open → $\dot{V}_{mid}$			
	>9 V → $\dot{V}_{max}$			
Y1	open	G0	G0	open
Y2	open	open	G0	G0
Action	CAV step mode	Dir **r** → rotation CW Dir **L** → rotation CCW **“Fully open“**	CAV step mode	Dir **r** → rotation CCW Dir **L** → rotation CW **“Fully closed“**

Note

Setting $\dot{V}_{min}$ ≤ 0 drives the actuator to position “fully closed”.

5.2.1 Calculation formulas

The parameters are based on the following formulas:

Calculation of Vn (Δpnom = nominal pressure)

$$V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}}$$

300 Pa is the upper limit of the operating range of the differential pressure sensor. The nominal pressure is the differential pressure in the VAV box at a given nominal volume flow, determined by the OEM specification.

Min. and max. volume flows (Vmin / Vmax)

$$V_{min}[\%] = \frac{min.\ volume\ flow\ [m^3/h]}{nom.\ volume\ flow\ [m^3/h]} \cdot 100\%$$

$$V_{max}[\%] = \frac{max.\ volume\ flow\ [m^3/h]}{nom.\ volume\ flow\ [m^3/h]} \cdot 100\%$$

Actual relative flow as function of setpoint and min. / max. limits

$$FLW\ [\%] = \frac{Setpoint\ [\%] \cdot (V_{max} - V_{min})\ [\%]}{100\%} + V_{min}\ [\%]$$

Actual relative flow as function of differential pressure

$$FLW\ [\%] = 100\% \cdot V_n \cdot \sqrt{\frac{\Delta p[Pa]}{300[Pa]}}$$

Actual differential pressure as function of actual flow

$$\Delta p[Pa] = 300\ Pa \cdot \left(\frac{FLW[\%]}{100\% \cdot V_n}\right)^2$$

5.2.2 Conversion of C-values into Vn values

In case the C-value of a VAV box is known, it can be converted into a corresponding Vn value as both are linked by Δpnom.

Formulas are linked by Δpnom

$$\dot{V}_{nom} = C \cdot \sqrt{\Delta p_{nom}} \text{ and } V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}} \rightarrow V_n = C \cdot \frac{\sqrt{300\ [Pa]}}{\dot{V}_{nom}}$$

Example for a box with C = 57.2 and Vnom = 900 m3/h:

$$V_n = C \cdot \frac{\sqrt{300\ [Pa]}}{\dot{V}_{nom}} = 57.2 \frac{[m^3/h]}{[\sqrt{Pa}]} \cdot \frac{\sqrt{300\ [Pa]}}{900\ [m^3/h]} = 1.1$$

In this case, set Vn = 1.1 which corresponds to a Δpnom = 248 Pa.

5.3 Configuration and maintenance tools

Configuration and retrieval of device parameters can be accomplished with the following tools:

- Using the PC software ACS941 or ACS931 together with the interface converter AST22 via the configuration and maintenance interface of the VAV Compact Controller or
- Using the handheld tool AST20.

5.3.1 PC software ACS941 and ACS931

Areas of use

The PC software versions ACS931 (for OEMs) and ACS941 (for service and maintenance staff) is used for setting and displaying the parameter values on a PC. Instructions for use of this software can be found in [7] and [8].

The PC software ACS941 allows to set or to display the parameters as listed in chapter Fehler! Verweisquelle konnte nicht gefunden werden.. The software supports trend functions and allows comparing the values set by the OEM with the values currently stored in the device. Thus, changes by parties other than the OEM can be detected.

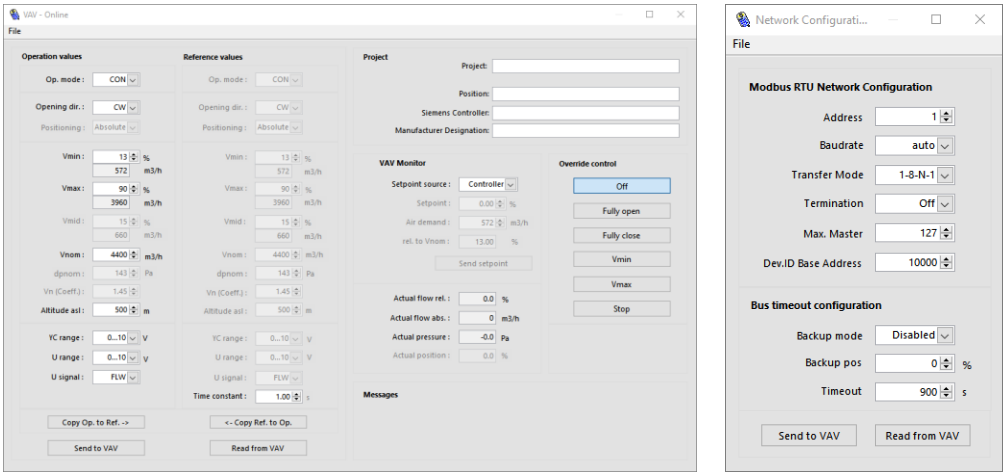


Figure 1: ACS941 with VAV (left) and network (right) configuration pane

Next to the PC software ACS941, an OEM version ACS931 with extended functionality is available as well. ACS931 allows setting the parameter V_n and changing the OEM default values. Its distribution is therefore restricted to OEM customers. For more details, see [7].

5.3.2 Handheld tool AST20

Functionality

Using the handheld tool AST20, VAV and actuator parameters can be set or retrieved, and device info and statistics can be read out. Instructions for use of the handheld tool AST20 can be found in data sheet [5].



Design

The AST20 is designed for portable use on-site. Power supply and establishing the communication between AST20 and a VAV Compact Controller are realized with one of the connection cables which are shipped with the AST20.

5.4 Setting examples

5.4.1 Symbols and parameters

Volume symbols with “point” ($\dot{V}$) and without point (V) shall have the same meaning, i.e., they all shall refer to volume flows.

Legend to the setting examples

$\dot{V}$	Volume flow [%]
$\dot{V}_{min}$	Minimum volume flow [%]
$\dot{V}_{max}$	Maximum volume flow [%]
$\dot{V}_{supply_air}$	Volume flow of supply air controller [%]
$\dot{V}_{extract_air}$	Volume flow of extract air controller [%]
$\dot{V}_{master}$	Volume flow of supply air controller (Master) [%]
$\dot{V}_{slave}$	Volume flow of extract air controller (Slave) [%]

5.4.2 Min/max control by the supervisory controller

When setting the minimum / maximum air volume flow in the supervisory controller, the VAV compact controller has to be configured with $\dot{V}_{min}$ = 0% and $\dot{V}_{max}$ = 100 %.

Setting example A1

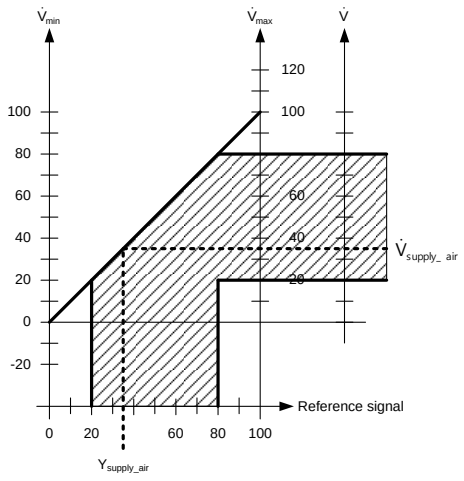
VAV ratio control 1 : 1

	Supply air		**Extract air**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	**20 %**	**80 %**	**20 %**	**80 %**
VAV compact controller	0 %	100 %	0 %	100 %

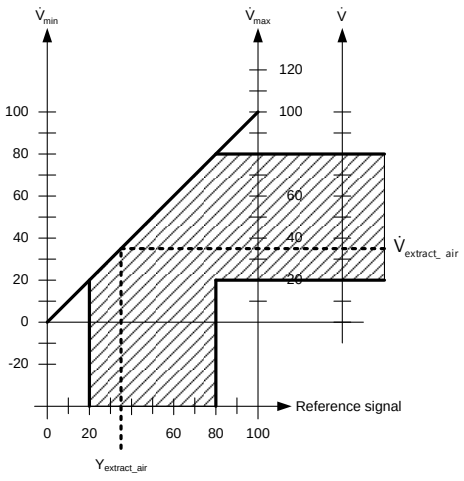
Reference signal: $Y_{supply_air} = Y_{extract_air} = 35$ %

Result: $V_{supply_air} = V_{extract_air} = 35$ %

Supply air controller



Extract air controller



Setting example A2

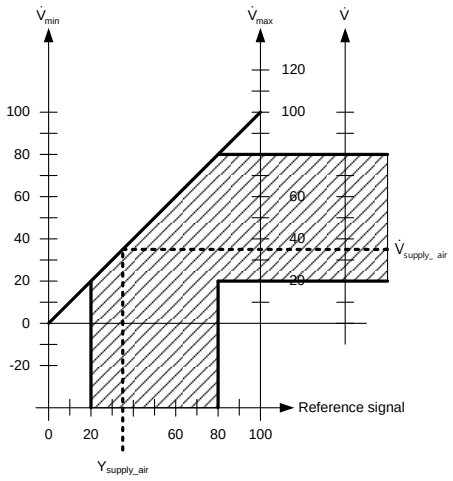
VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	**20 %**	**80 %**	**0 %**	**60 %**
VAV compact controller	0 %	100 %	0 %	100 %

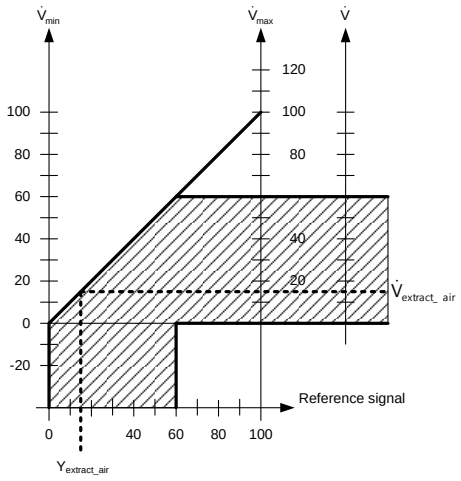
Reference signal: Y_{supply_air} = 35 %, $Y_{extract_air}$ = Y_{supply_air} - 20 % = 15 %

Result: V_{supply_air} = 35 %, $V_{extract_air}$ = 15 %

Supply air controller



Extract air controller



Setting example A3

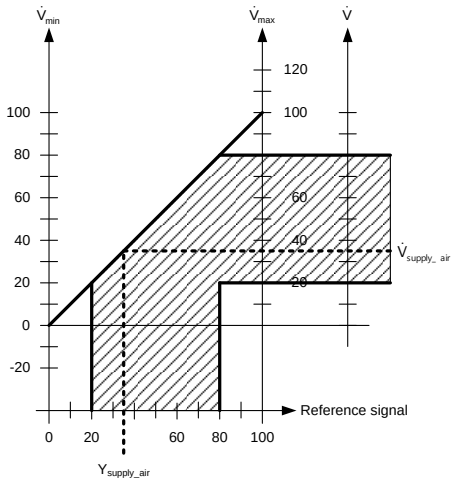
VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	**20 %**	**80 %**	**40 %**	**100 %**
VAV compact controller	0 %	100 %	0 %	100 %

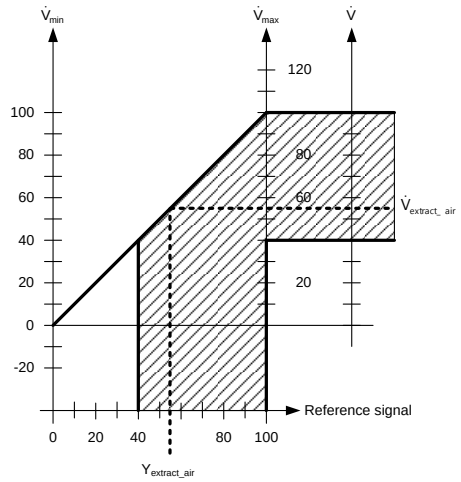
Reference signal: Y_{supply_air} = 35 %, $Y_{extract_air}$ = Y_{supply_air} + 20 % = 55 %

Result: V_{supply_air} = 35 %, $V_{extract_air}$ = 55 %

Supply air controller



Extract air controller



5.4.3 Min/max control by the VAV compact controller

When setting the minimum / maximum air volume flow in the VAV compact controller, the supervisory controller must be set to V_{min}= 0% und V_{max} = 100 %. With this setting, the supervisory controller reference signal for both the supply air and extract air controller is the same. Thus, supply air / extract air control with a single reference signal is possible.

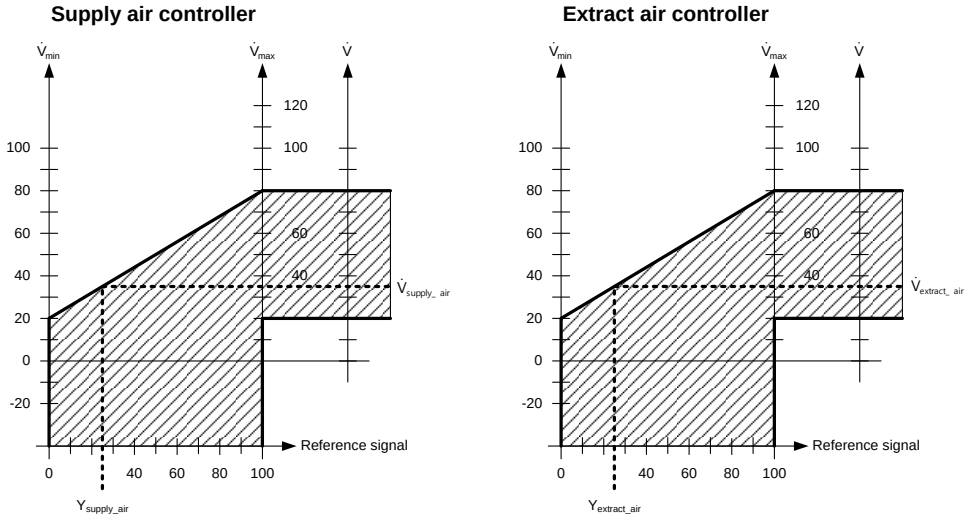
Setting example B1

VAV ratio control 1 : 1

	Supply air		**Extract air**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**20 %**	**80 %**

Reference signal: $Y_{supply_air} = Y_{extract_air} = 25$ %

Result: $V_{supply_air} = V_{extract_air} = 35$ %



Setting example B2

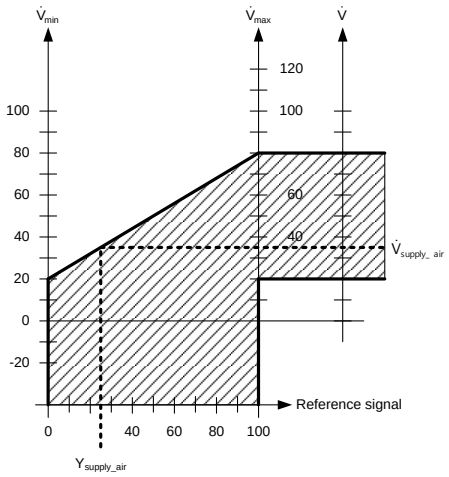
VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**0 %**	**60 %**

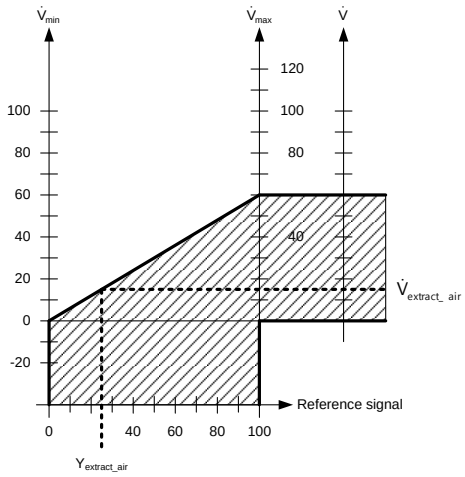
Reference signal: $Y_{supply_air} = Y_{extract_air} = 25\ \%$

Result: $V_{supply_air} = 35\ \%$, $V_{extract_air} = 15\ \%$

Supply air controller



Extract air controller



Setting example B3

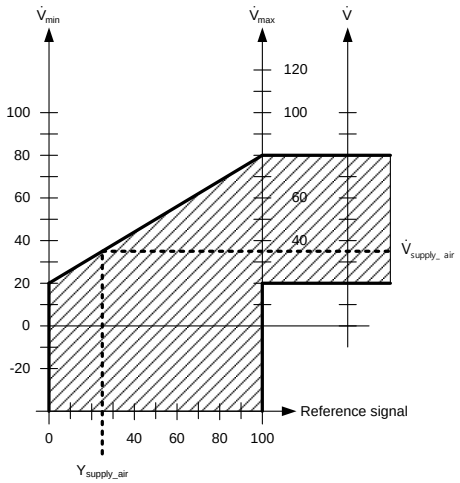
VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**40 %**	**100 %**

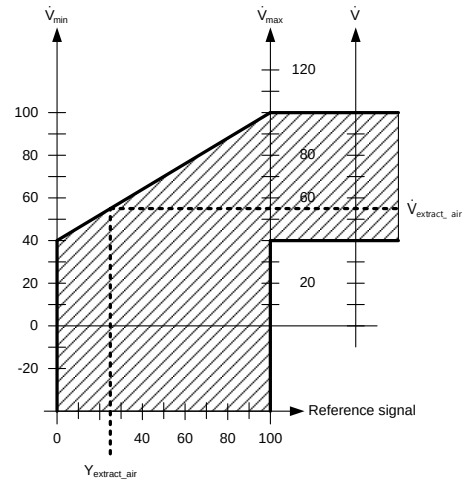
Reference signal: $Y_{supply_air} = Y_{extract_air} = 25\ \%$

Result: $V_{supply_air} = 35\ \%$, $V_{supply_air} = 55\ \%$

Supply air controller



Extract air controller



5.4.4 Master/Slave operating mode

To control supply air and extract air in master/slave operating mode, the actual value signal of the master controller (supply air) is the reference signal for the slave controller (extract air).

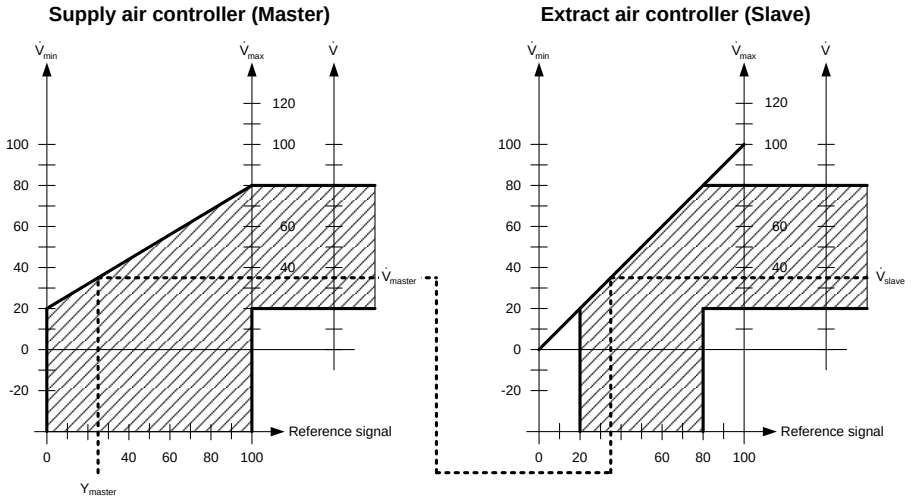
Setting example C1

VAV ratio control 1 : 1

	Supply air (Master)		**Extract air (Slave)**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**0 %**	**100 %**

Reference signal: Y_{master} = 25 %

Result: $V_{master} = V_{slave}$ = 35 %



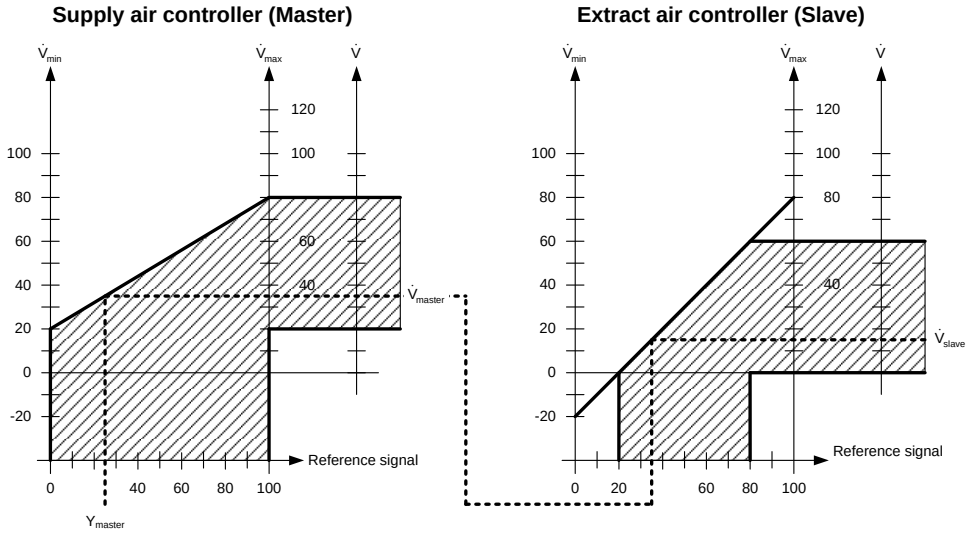
Setting example C2

VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air (Master)		Extract air (Slave)	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**-20 %**	**80 %**

Reference signal: Y_{master} = 25 %

Result: V_{master} = 35 %, V_{slave} = 15 %



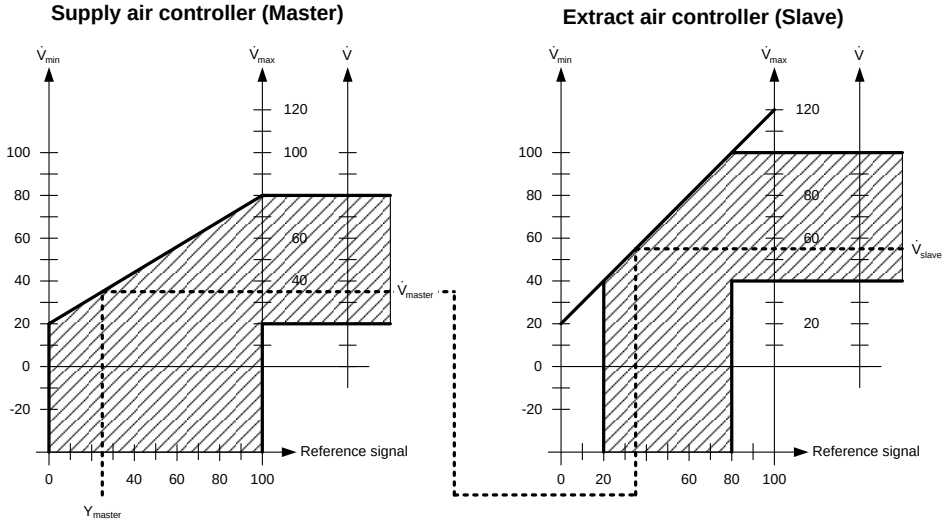
Setting example C3

VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air (Master)		Extract air (Slave)	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**20 %**	**120 %**

Reference signal: Y_{master} = 25 %

Result: V_{master} = 35 %, V_{slave} = 55 %



6 Commissioning

6.1 Documentation of engineering and commissioning

Use of planning and commissioning protocol recommended

It is highly recommended to document all planning data and settings in a way that is easily accessible after a long interval. Especially if special calculated parameters or plant-specific adaptations had to be made during engineering and commissioning, these should be clearly noted.

6.2 Commissioning

The type field on the VAV box usually provides information about the configuration made in the factory.

The following notes are intended to help in the case of malfunctioning of VAV compact controller or if parameters were changed on site:

- Check mechanical settings according to the data specified for the plant in question, especially whether the dampers are airtight in their fully closed position
- Check direction of rotation (opening direction).
- Dampers or actuator can be manually overridden by moving the red slider for disengaging the gear train, but only when power is turned off.
- Make certain the actuator cannot be twisted and that it cannot jam.
- Check to ensure that the tubes for measuring the differential pressure are correctly connected.
- To check the setting values of $\dot{V}_n$, $\dot{V}_{max}$, $\dot{V}_{min}$, the operating mode (“con”, “3P” or “STP”) and the actuator’s opening direction (counterclockwise or clockwise), the AST20 setting unit or ACS941 software with AST22 interface converter is required.
  If digital setpoints or control command (on, stop, off) are predefined via AST20 or ACS941, wait one minute after disconnecting the AST20 or AST22 from the VAV compact controller for YC, Y1 and Y2 to work as specified.

Devices series A and B (as of series C, disconnection is no longer required)

- If the “Operating mode” parameter is changed, the supply of power (AC 24 V) to the VAV compact controller must be disconnected for a short moment, enabling the change to become effective.

Devices until index D

- The sensor output signal only becomes valid 2 minutes after supplying power (AC 24 V) or after a power cut. During this time, the VAV compact controller performs a zero-point calibration of the differential pressure sensor .

- If communication with the AST20 / AST22 is made via the YC core, the relevant cores of parallel wired VAV compact controllers must be disconnected for the period of time communication is active!
- For more detailed information, please refer also to AST20 datasheet [5].

7 Safety and EMC optimization

7.1 Safety notes



This section contains general regulations and the regulations for mains and operating voltage. It also provides important information regarding your own safety and that of the entire plant.

⚠ Safety note

The warning triangle to the left means that observance of all relevant regulations and notes is mandatory. If ignored, injury to persons or damage to property may result.

⚠ General regulations

Observe the following regulations during engineering and project execution:

- Electrical and high-voltage directives of the respective country
- Other country-specific regulations
- House installation regulations of the respective country
- Regulations issued by the utility
- Diagrams, cable lists, disposition drawings, specifications and instructions as per the customer or the contractor in charge
- Third-party regulations issued by general contractors or building operators

Safety

The electrical safety of building automation and control systems supplied by Siemens depends primarily on the use of **extra low-voltage with safe isolation from mains voltage.**

SELV, PELV

Depending on the type of extra low-voltage earthing, a distinction is to be made between SELV and PELV as per HD 384, “Electrical plants in buildings“:
Unearthed = **SELV** (**S**afety **E**xtra **L**ow Voltage)
Earthed = **PELV** (**P**rotective **E**xtra **L**ow **V**oltage)

⚠ Earthing of G0 (system neutral)

Observe the following for grounding G0:
As a rule, earthing and non-earthing of G0 is permissible for AC 24 V operating voltage. Decisive are the local regulations and customary procedures. For functional reasons, earthing may be required or not permissible.

Recommendation on earthing G0

AC 24 V systems should always be earthed if this does not contradict the manufacturer’s specification.
To avoid earth loops, systems with **PELV may only be earthed at one point of the system,** normally by the transformer, unless otherwise specified.

Operating voltage AC 24 V

With regard to AC 24 V operating voltage, the following regulations must be complied with:

	Regulation
Operating voltage AC 24 V	The operating voltage must comply with the requirements for SELV or PELV: • Permissible deviation of AC 24 V nominal voltage at the actuators: +/–20 %
Specification on AC 24 V transformers	• Safety isolating transformers as per EN 61558, with double insulation, designed for 100 % on time to power SELV or PELV circuits • Determine the transformer's output by adding up the power consumption in VA of all actuators used • For efficiency reasons, the power drawn from the transformer should amount to at least 50 % of the nominal load • The transformer's nominal capacity must be at least 25 VA. With smaller transformers, the ratio of no-load voltage and full load voltage becomes unfavorable (> + 20 %)
Fusing of AC 24 V operating voltage	Secondary side of transformer: • According to the effective load of all connected devices • Line G (system potential) must always be fused • Where required, line G0 (system neutral) also

7.2 Device-specific regulations

⚠ Device safety

Among other aspects, the safety of devices is ensured by extra low-voltage power supply (AC 24 V) as per **SELV** or **PELV**.

Electrical parallel connection

Electrical parallel connection of VAV compact controllers provided the required operating voltage tolerance is observed. The **voltage drops of the supply lines** must be taken into consideration.

Mechanical coupling of the devices is not permitted.


Warning, maintenance

Do not open the actuator!
The device is maintenance-free. Only the manufacturer may carry out any repair work.

7.3 Notes on EMC optimization

Running cable in a duct

Make sure to separate high-interference cables from equipment susceptible to interference.

Cable types

- Cable causing interference: Motor cables, especially motors used with VSDs, energy cables
- Cables susceptible to interference: Control cables, low-voltage cables, interface cables, LAN cables, digital and analog signal cables

Cable segregation

- You can run both types of cable in the same duct, but in different compartments
- If ducting with 3 closed sides and a partition is not available, separate the interference-emitting cables from other cables by a minimum of 150 mm, or route in separate ducting
- Cross high-interference cables with equipment susceptible to interference only at right angles
- If, in exceptional cases, signal and interference-emitting power cables are run in parallel, the risk of interference is high. In that case, limit the cable length of the DC 0/2...10 V positioning signal line for modulating actuators

Unshielded cables

In general, the use of unshielded cables is recommended. When selecting unshielded cables, the manufacturer’s installation recommendations have to be followed. In general, **unshielded twisted pair cables** for building services plant (including data lines) offer adequate EMC characteristics, plus the advantage that no provision is required for coupling to earth.

8 Technical data

⚠ **Power supply AC 24 V** (SELV/PELV) G and G0		
G..B181.1E/3, ASV181.1E/3	Operating voltage / frequency	AC 24 V ±20 % / 50/60 Hz
G..B181.1E/3	Power consumption at	
	Actuator holds	1 VA / 0.5 W
	Actuator rotates	3 VA / 2.5 W
ASV181.1E/3	Power consumption	1 VA / 0.5 W
Damper actuator (G..B181.1E/3)		
	Nominal torque	5 Nm (GDB) / 10 Nm (GLB)
	Maximum torque	<7 Nm (GDB) / <14 Nm (GLB)
	Nominal rotation angle / maximum rotation angle	90° / 95° ±2°
	Running time for nominal rotation angle 90°	150 s (50 Hz) / 125 s (60 Hz)
	Direction of rotation (adjustable with e.g. **ACS941**)	Clockwise / counter clockwise
Signal inputs		
Air volume flow reference or communication signal YC (core 8)	Input voltage	DC 0/2 … 10 V
	Max. perm input voltage	DC 35 V
Reference signals Y1 (core 6) and Y2 (core 7)	Contact sensing	
	Contact open	DC 30 V contact voltage
	Contact closed	DC 0 V, 8 mA contact current
Signal outputs		
Air volume flow measuring signal U (core 9)	Output voltage	DC 0/2…10 V limited to DC 12 V
	Max. output current	DC ± 1 mA
	Time constant (actual value U)	0.05…5 s
	Resolution 0.01 s / factory setting 1 s	
Configuration and maintenance interface		
	Series A - D	**6-pin**, grid 2.54 mm
	Series E or later	**7-pin**, grid 2.00 mm
Power / communication cable		
Connection cable	Cable length	0.9 m
(G..B181.1E/3, ASV181.1E/3)	Number of cores and cross-sectional area	6 x 0.75 mm^2
Actuator control cable	Cable length	0.3 m
(ASV181.1E/3)	Number of cores and cross-sectional area	4 x 0.75 mm^2
⚠ **Degree of protection and safety class**		
G..B181.1E/3	Degree of protection acc. to EN 60529	IP54
	(cf. mounting instructions M3544 / M3545)	
ASV181.1E/3	Degree of protection acc. to EN 60529	IP40
	(cf. mounting instructions M3544 / M3545)	
	Safety class acc. to EN 60730	III
Environmental conditions		
	Operation / transport	IEC 721-3-3 / IEC 721-3-2
	Temperature	0...50 °C / –25…70 °C
	Humidity (non-condensing)	<95% r.h. / <95% r.h.
Standards and Regulations		
Product safety	Automatic electric controls for household and similar use	EN 60730-2-14 (mode of action type 1)
Electromagnetic compatibility (Application)	For residential, commercial and industrial environments	

	GDB181.1E/3	GLB181.1E/3	ASV181.1E/3
EU Conformity (CE)	A5W00003842 [1]	A5W00000176 [1]	A5W00004387 [1]
	GDB181.1E/3	GLB181.1E/3	ASV181.1E/3
RCM Conformity	A5W00003843 [1]	A5W00000177 [1]	A5W00004388 [1]
Environmental compatibility	CM2E4634E [1]		CM2E3545 [1]
	The product environmental declaration contains data on environmentally compatible product design and assessments (RoHS compliance, materials composition, packaging, environmental benefit, disposal).		

Dimensions		
G..B181.1E/3	W x H x D	71 x 158 x 61 mm
ASV181.1E/3	W x H x D	68 x 135 x 45 mm

Suitable drive shafts		
Type of drive shaft	Round	8...16 mm
	Round, with centering element	8...10 mm
	Square	6...12.8 mm
	Hexagonal	<15 mm
	Min. drive shaft length	30 mm
	Max. shaft hardness	<300 HV
Weight		
G..B181.1E/3	Without packaging	0.6 kg
ASV181.1E/3	Without packaging	0.28 kg
Air volume controller		
3-position controller with hysteresis	$\dot{V}_{max}$, adjustable (resolution 1 % / factory setting 100 %)	20…120 %
	$\dot{V}_{min}$, adjustable (resolution 1 % / factory setting 0 %)	-20…100 %
	$\dot{V}_{mid}$, adjustable (resolution 1 % / factory setting 50 %)	0…100 %
	$\dot{V}_n$, adjustable (resolution 0.01 / factory setting 1.00)	1…3.16
	$\dot{V}_n$ = 1 ≙ 300 Pa at nominal air volume flow	
	$\dot{V}_n$ = 3.16 ≙ 30 Pa at nominal air volume flow	
Differential pressure sensor		
	Connection tubes (interior diameter)	3…8 mm
	Measuring range	0…500 Pa
	Operating range	0…300 Pa
	Precision at 23 °C, 966 mbar and optional mounting position	
	Zero point	± 0.2 Pa
	Amplitude	± 4.5 % of the measured value
	Drift	± 0.1 Pa / Year
	Max. permissible operating pressure	3000 Pa
	Max. permissible overload on one side	3000 Pa

[1] The documents can be downloaded from http://siemens.com/bt/download

9 Datapoints and function description

9.1 Device Parameters (ACS931 / ACS941 / AST20)

Parameter	Range	Description	Factory setting	Read / Write
Setpoint	0-10 V / 2-10 V (0..100%)	Setpoint to VAV controller, *relative to Vmin-Vmax operating range* 0% → Vmin / 100% → Vmax	N/A	ACS931, ACS941, AST20
Actual position	0..100%	Damper position, depends on setting for position adaptation	N/A	ACS931, ACS941, AST20
Actual Flow abs.	0..65'535 m^3/h	Actual volume flow in m^3/h or l/s	N/A	ACS931, ACS941, AST20
Actual Flow %	0..100%	Actual volume flow relative to Vnom in %	N/A	ACS931, ACS941, AST20
Actual pressure	0..300 Pa	Actual differential pressure	N/A	ACS931, ACS941, AST20
Override control	Open / Close / Stop / Min / Max	Override control from config. / maintenance tool	N/A	ACS931, ACS941, AST20
Operating mode (depends on wiring)	VAV (con) / 3P / STP	VAV (con) = Setpoint 0..100% volume flow 3P = Setpoint 0..100% damper position STP = Close / Vmin / Vmid / Vmax / Open	VAV	ACS931, ACS941, AST20
Opening direction	UZS / GUZS	Opening direction of air damper	UZS	ACS931, ACS941, AST20
Positioning	Absolute / Adaptive	Adaption of actual opening range to position feedback Off = No adaptation / mapping 0°...90° → 0..100 % On = Pos. adaptation / mapping e.g. 0°...60° → 0..100 %	Absolute	ACS931, ACS941, AST20
Vmin	-20..100%	Minimum air volume flow, relative to Vnom	0 %	ACS931, ACS941, AST20
Vmax	20..120%	Maximum air volume flow, relative to Vnom	100 %	ACS931, ACS941, AST20
Vnom	0..65'535 m^3/h	Nominal air volume flow	100 m^3/h	ACS931, ACS941, AST20 [1)]
Vn (Coefficient)	1..3.16	Characteristic value for the VAV box; set by the OEM	1.00	ACS931, AST20 [1)]
dpnom	30..300 Pa	Nominal differential pressure, corresponds to Vn	300 Pa	ACS931
Altitude asl.	0..5000m, in 500m steps	Altitude level correction, select n*500m value closest to altitude of installation	500 meter	ACS931, ACS941, AST20
YC range	0…10 V / 2…10 V	Setpoint signal at YC	0…10 V (Op. mode CON / VAV)	ACS931, ACS941, AST20
U range	0…10 V / 2…10 V	Actual value, depends on the setting for U signal	0…10 V	ACS931, ACS941, AST20
U signal	FLW / POS	Actual value FLW = volume flow [%] POS = damper position [%]	FLW	ACS931, ACS941, AST20
Time constant U	0.05…5 s	Smoothing constant actual value U	1 s	ACS931, ACS941, AST20
Unit vol. flow	m^3/h / l/s	Unit in which the volume flow is displayed	m^3/h	ACS931, ACS941, AST20
Unit Vmin & Vmax	%, m^3/h or l/s	Unit in which Vmin / Vmax are entered	%	AST20

9.2 Parameters and function description

9.2.1 Vnom (nominal volume flow) [m³/h or l/s]

VAV boxes are ordered through an OEM according to this nominal volume flow and min. / max. volume flow settings. The maximum volume flow for ventilating a room / zone can't be higher than the nominal volume flow.

9.2.2 Vmin / Vmax (minimum / maximum volume flow) [%]

These values limit the nominal volume flow and are relative to Vnom. Their effect is described in chapter **5.**

9.2.3 Elevation above sea level [m]

This value enhances the accuracy of the differential pressure sensor to compensate for the air density decreasing with increasing altitude. It can be set in 500m steps, so for a given building the setting closest to the actual altitude is to be used.

Example: Altitude of building: 420m a.s.l. → use setting "500m"

9.2.4 Override control

The actuator can be operated in override control for checking / maintenance purposes or system-wide functions (e.g. night-cooling).

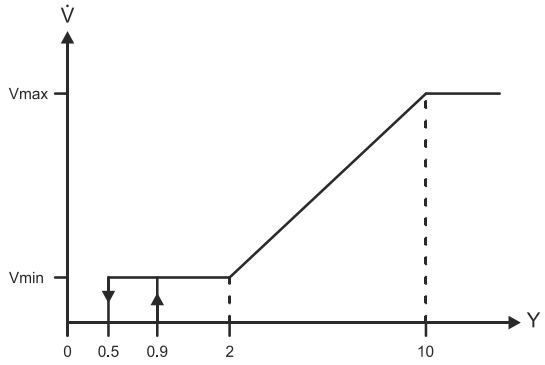
9.2.4.1 Local override:

The actuator enters this state when a service tool is connected at the service interface (PPS2).

- Open / Close (depends on opening direction)
- Stop
- If the actuator is in backup mode, it will be controllable in local override but resume the backup mode
  - when the service tool is disconnected,
  - when the local override timeout is exceeded, or
  - when the override control is set to "off".
- Timeout is 60s after the last read or write access resp. after disconnecting the service tool.

9.2.4.2 Remote override:

When the setpoint signal range (YC) is set to DC 2…10 V, the actuator can be driven to "fully closed" by setting YC = 0 V. The hysteresis behavior is shown in the diagram below.



9.2.5 Adaptive positioning

9.2.5.1 Function

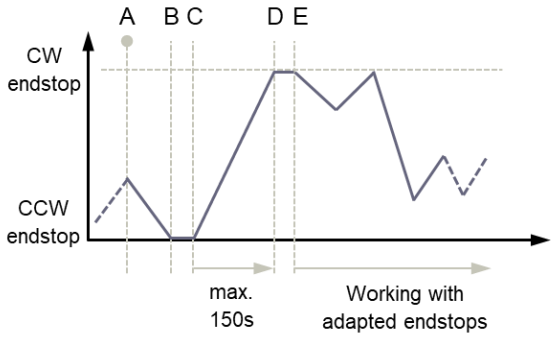
For VAV boxes and air dampers with an opening range smaller than 0...90°, the position feedback signal can be adapted to 0...100% if the signal type for the output U is set accordingly.

- Adaptive positioning **off**: Feedback relative to 0°…90°,
  →Example: 0° → 0%, 18° → 20%, 81° → 90% etc.

- Adaptive positioning **on**: Feedback relative to the *mechanical* lower / upper endstops which are determined in an adaptation run.
  →Example: The lower endstop is at 15° and the upper endstop is at 60°
  15° → 0%, 45° → 66%, 60° → 100% etc.

9.2.5.2 Activation and deactivation

- Immediately after changing the parameter “Adaptive positioning” from **off** to **on**, an adaptation run is performed. During the adaptation run, the actuator drives to both mechanical end stops and stores these positions persistently as 0% and 100% reference points. Cf. diagram below for a detailed description.
- Adaptive positioning can be (de-)activated with the service interface (ACS931 / ACS941 / AST20).
- If adaptive positioning is deactivated *before the adaptation run has finished*, the adaptation run will stop immediately, and no end stops will be stored.
- In case of a power reset during the adaptation run, the adaptation run will restart automatically after the power supply has been restored.
- To trigger the adaptation run again the adaptive positioning must be turned off and on again.
- A manual gear disengagement of less than 20 seconds doesn’t impact the adaptation run or its result.



A. Adaptive positioning is set to on. Actuator drives to the counter-clockwise (CCW) endstop.
B. CCW endstop is reached.
C. If the position remains constant for about 10 seconds, it is stored non-volatile. The actuator then drives to the clockwise (CW) endstop.
D. CW endstop is reached.
E. If the position remains constant for about 10 seconds, it is stored non-volatile. The actuator now follows the adapted setpoint.



Example: Stop screw set at ~75% of the full range

Note: If the adaptation run starts close to the CW endstop, it can take up to 5.5 minutes for completion (2x 150s + waiting times in the endstops).

9.2.6 Operating mode

The operating mode determines whether the setpoint signal (0…100 %) from the supervisory controller is interpreted as volume flow control or as (air damper) position control.

If used as damper control signal, the actual values from the flow sensor remain available. This allows to implement the flow control loop in an external controller.

9.2.7 Restarting the device

Restarting is possible by a power-reset (switching operating voltage off and on). Effect of restart: Device re-initializes and sets all process values to defaults. Parameter values are not reset.

9.3 Communication object priorities

The communication objects are prioritized as listed in the table below. An override signal is active until it is disabled or the tool is disconnected from the VAV compact controller.

Priority	State	Behavior after power reset
1	Manual gear disengagement	Independent
2	Adaptation run	Will be restarted all over
3	Override control from tool	Will be reset
4	Override control (Y1/Y2)	Will be reset
5	Sensor communication error [1)]	Will be reset [2)]
6	Closing due invalid signal Yc in 2-10 V	Will be reset
7	Setpoint from tool	Will be reset
8	Setpoint Yc	Will be reset

1) As of firmware version 7.17: Damper drives to “fully open”

2) Only effective in VAV mode

10 Environmental compatibility and disposal

General notes

The products were developed and manufactured by using environmentally compatible materials and by complying with environmental standards.
For disposal, please remember the following at the end of product life or in case of defects:

- The products consist of plastics and materials such as steel, ferrite magnetic core, etc. and must not be disposed of together with domestic waste; this applies particularly to the printed circuit boards.

  See also European Directive 2012/19/EU
- As a rule, dispose of all waste in an environmentally compatible manner and in accordance with the latest developments in environmental, recycling and disposal techniques.
  Local and currently valid legislation must be observed.
- The aim is to achieve maximum recyclability of the basic materials while ensuring minimum strain on the environment. To do this, note the various material and disposal notes printed on specific components

Environmental declaration

The Environmental Declarations on these products contain detailed information about the materials and volumes used. If you need a copy, please contact your Siemens sales office.

Issued by
Siemens Switzerland Ltd
Smart Infrastructure
Global Headquarters
Theilerstrasse 1a
6300 Zug
Switzerland
Tel. +41 41-724 24 24
www.siemens.com/buildingtechnologies

© Siemens Switzerland Ltd, 2011
Technical specifications and availability subject to change without notice.