



Datasheet

Servo-air Ventilator System v4.6

1 Available modes and functions

X = standard

— = not applicable

O = option

Modes/Functions	Configuration
PC	X
PRVC	O
VC	X
Bi-Vent/APRV	O
PS/CPAP	X
VS	O
Automode	O
SIMV	
(PC) + PS	X
(PRVC) + PS	O
(VC) + PS	X
NIV PC	O
NIV PS	O
High Flow therapy	O
CO ₂ analyzer	O
Servo Compass	O
Nebulizer	X
Alarm output connection	O

2 System

General	
Standards	▪ IEC 60601-1: 2005 + A1:2012 + A2:2020, Class I, continuous operation - Applied parts – Equipment making physical contact with the patient and the gas path ways. Type B – Nebulizer patient unit and cable. Type BF – CO₂ sensor. Type BF ▪ ISO 80601-2-12:2020 ▪ ISO 80601-2-55:2018 ▪ ISO 80601-2-90:2021 ▪ EN 13544-1:2007 + A1:2009
Electromagnetic disturbance	According to IEC 60601-1-2:2014 + A1:2020.

General	
Patient category	Tidal volume ▪ Pediatric: 20 - 400 ml ▪ Adult: 100 - 2000 ml Patient weight ▪ Pediatric: 5 - 50 kg ▪ Adult: 15 kg and above
Ingress protection	IP 21
Noise	▪ A-weighted sound power level (LWA): <61 dB

Operating conditions	
Operating temperature range	10 to 40°C
Relative humidity	15 to 95 % non-condensing
Atmospheric pressure	660 to 1060 hPa
Lowest pressure in patient circuit	-400 cmH ₂ O

Non operating conditions	
Storage temperature	5 to 40°C
Storage relative humidity	5 to 85% non-condensing
Storage atmospheric pressure	660 to 1060 hPa

Power supply	
Power supply, automatic range selection	Rated input power ▪ 100 - 240 V AC ±10%, 50-60 Hz
Typical mean power consumption, range	30 - 100 W
External 12 V battery	12.0 V lead acid battery, minimum 7 Ah Applicable standard: UL 1989
Battery module	▪ 1 - 2 battery modules rechargeable 14.4 V ▪ Battery backup time factory new battery 2 h fully charged. ▪ Typical recharge time approximately 2 h/battery (90%), up to 4 h (100%) if battery is completely discharged. Usable backup time depends on set mode and selected ventilation settings.

3 Ventilator system

General	
Dimensions	- User interface: W 300 x D 34 x H 248 mm - Patient unit: W 375 x D 350 x H 275 mm
Weight	Approx. weight: 17 kg

Gas supply	
Ambient air	Dust and HEPA filtered ambient air.
Gas quality, O ₂	Supplied gas must meet the requirements for medical grade gases according to applicable standards.
Inlet gas, O ₂	Pressure: 2.0 – 6.0 kPa x 100 (29 – 87 psi)
Connection standards available	AGA, DISS, NIST, or French

Patient system connectors	
Conical fittings	Nominal 22 mm and 15 mm, in accordance with ISO 5356-1
Gas exhaust port	Male 30 mm cone

4 Inspiratory channel

Inspiratory channel	
Pressure drop	Maximum: 6 cmH ₂ O at a flow of 60 l/min
Gas delivery system	Air turbine and O ₂ valve
Gas delivery device	- Flow range: - Pediatric: 0 - 240 l/min - Adult: 0 - 240 l/min - Maximum pressure setting: - Pediatric: 80 cmH₂O - Adult: 100 cmH₂O
NIV max. leakage compensation level	- Pediatric: Inspiratory leakage up to max inspiratory flow. Expiratory leakage up to 25 l/min. - Adult: Inspiratory leakage up to max inspiratory flow. Expiratory leakage up to 65 l/min.
Inspiratory tidal volume	Air/O ₂ Setting range: - Pediatric: 20 - 400 ml - Adult: 100 - 2000 ml
High Flow therapy	Flow setting range: - Pediatric: 2 - 50 l/min. - Adult: 5 - 60 l/min. Inaccuracy: ±(0.5 l/min + 8% of set value)

5 Expiratory channel

Expiratory channel	
Pressure drop	Maximum: 3 cmH ₂ O at a flow of 60 l/min
Internal compressible factor	Maximum: 0.1 ml/cmH ₂ O
PEEP regulation	Microprocessor controlled valve
Expiratory flow measurements	▪ 0 - 192 l/min
Bias flow during expiration	2 l/min

6 Display

Views	▪ Basic ▪ Advanced ▪ Loops ▪ Distance ▪ Family ▪ Servo Compass (option) ▪ Each of the screen layout views offers a specific combination of displayed waveforms, loops and presented values.
Real time waveforms	▪ Pressure ▪ Flow ▪ Volume ▪ CO₂ (option)
Loops	▪ Pressure – Volume ▪ Volume – Flow A reference loop and three overlaying loops can be displayed.
Servo Compass	Visualizes volume (VT/PBW) and pressure (total or driving) in relation to set targets in invasive modes.

7 Ventilatory settings

Settings	Setting range	
		
Maximum apnea time in Automode (s)	3 - 15	7 - 12
Breath cycle time, SIMV (s)	0.5 - 15	1 - 15
Respiratory rate (b/min)	4 - 150	4 - 100
Respiratory rate (b/min) in NIV	4 - 150	4 - 100
Circuit compensation	ON/OFF	ON/OFF
Flow trigger level in invasive modes, (l/min)	0 - 2	0 - 2
I:E ratio	1:20 - 4:1	1:20 - 4:1
I:E ratio in backup	1:20 - 4:1	1:20 - 4:1
End inspiration (% of peak flow)	1 - 70	1 - 70

Settings	Setting range	
		
End inspiration (% of peak flow) in NIV	10 - 70	10 - 70
Inspiratory rise time (%)	0 - 20	0 - 20
Inspiratory rise time (s)	0 - 0.5	0 - 0.5
Inspiratory rise time (s) in NIV	0 - 0.5	0 - 0.5
Minute volume (l/min)	0.3 - 20	0.5-60
Nebulizer	ON/OFF	ON/OFF
Nebulizer time (min)	5 - 30, continuous nebulization	5 - 30, continuous nebulization
O ₂ boost level (%)	0 - 79	0 - 79
O ₂ concentration (%)	21 - 100	21 - 100
PEEP (cmH ₂ O)	0 - 50	0 - 50
PEEP in NIV (cmH ₂ O)	2 - 20	2 - 20
Phigh (cmH ₂ O)	2 - 50	2 - 50
Pressure trigger level (cmH ₂ O)	-1 --20	-1 --20
Pressure level above PEEP (cmH ₂ O)	0 - 80	0 - 100
Pressure level above PEEP in NIV (cmH ₂ O)	0 - 60	0 - 60
Pressure level above PEEP in backup (cmH ₂ O)	5 - 80	5 - 100
Pressure level above PEEP in NIV backup (cmH ₂ O)	5 - 60	5 - 60
PS above PEEP in Bi-Vent/APRV (cmH ₂ O)	0 - 80	0 - 100
PS above Phigh in Bi-Vent/APRV (cmH ₂ O)	0 - 78	0 - 98
Respiratory rate in backup (b/min)	4 - 150	4 - 100
SIMV frequency (b/min)	1 - 60	1 - 60
Thigh (s)	0.2 - 30	0.2 - 30
Ti (s)	0.1 - 5	0.1 - 5
Ti in backup (s)	0.1 - 5	0.1 - 5
Tidal volume (ml)	2 - 400	100 - 2000
Tidal volume in backup (ml)	2 - 400	100 - 2000
Tpause (%)	0 – 30	0 – 30
Tpause (s)	0 - 1.5	0 - 1.5
TPEEP (s)	0.1 - 10	0.1 - 10
VC Flow pattern (%)	0-100	0-100
Flow in High Flow therapy (l/min)	2 - 50	5 - 60

8 Alarms

Parameter	Setting range	
		
Airway pressure, upper limit (cmH ₂ O)	16 - 90	16 - 100
Airway pressure, upper limit (cmH ₂ O) in NIV	16 - 70	16 - 70
Airway obstructed pressure limit (cmH ₂ O)	—	—
Apnea time to alarm (s)	2 - 45	15 - 45
Expiratory tidal volume low (ml)	50 - 440	50 - 1900
Expiratory tidal volume, high (ml)	60 - 450	60 - 2000
End expiratory pressure, upper limit (cmH ₂ O)	1 - 55	1 - 55
End expiratory pressure, lower limit (cmH ₂ O)	0 - 47	0 - 47
Expired minute volume, lower limit (l/min)	0.1-15	0.5 - 40
Expired minute volume, upper limit (l/min)	0.15 - 20	1 - 60
Respiratory rate, lower limit (b/min)	1 - 159	1 - 159
Respiratory rate, upper limit (b/min)	2 - 160	2 - 160
etCO ₂ Lower alarm limit		
%	0.5 - 19.9	0.5 - 19.9
mmHg*	4 - 149	4 - 149
kPa*	0.5 - 19.9	0.5 - 19.9
etCO ₂ Lower alarm limit in NIV		
%	0 - 19.9	0 - 19.9
mmHg*	0 - 149	0 - 149
kPa*	0 - 19.9	0 - 19.9
etCO ₂ Upper alarm limit		
%	0.6 - 20	0.6 - 20
mmHg*	5 - 150	5 - 150
kPa*	0.6 - 20	0.6 - 20
etCO ₂ Upper alarm limit in NIV		
%	0.5 - 20	0.5 - 20
mmHg*	4 - 150	4 - 150
kPa*	0.5 - 20	0.5 - 20

8.1 Auto set alarm limits - controlled modes only

Auto set alarm limits - controlled modes only	
High airway pressure	Mean peak pressure +10 cmH ₂ O or at least 35 cmH ₂ O
Expiratory tidal volume (upper alarm limit)	Mean expiratory tidal volume +50%
Expiratory tidal volume (lower alarm limit)	Mean expiratory tidal volume -50%
Expiratory minute volume (upper alarm limit)	Mean expiratory minute volume +50%
Expiratory minute volume (lower alarm limit)	Mean expiratory minute volume -50%
Respiratory rate (upper alarm limit)	Mean respiratory rate +40%
Respiratory rate (lower alarm limit)	Mean respiratory rate -40%
End expiratory pressure (upper alarm limit)	Mean end expiratory pressure +5 cmH ₂ O
End expiratory pressure (lower alarm limit)	Mean end expiratory pressure -3 cmH ₂ O
End-tidal CO ₂ concentration (upper alarm limit)	Mean end-tidal CO ₂ concentration +25%
End-tidal CO ₂ concentration (lower alarm limit)	Mean end-tidal CO ₂ concentration -25%

9 Trends

Peak airway pressure	P _{peak}
Pause airway pressure	P _{plat}
Mean airway pressure	P _{mean}
Driving pressure	P _{drive}
Positive end expiratory pressure	PEEP
Spontaneous breaths per minute	RR _{sp}
Respiratory rate	RR
Spontaneous expiratory minute volume	MV _{e sp}
Inspired minute volume	MV _i
Expired minute volume	MV _e
Leakage (%)	Leakage
Inspired tidal volume	VT _i
Expired tidal volume	VT _e
End expiratory flow	Flow _{ee}
Measured oxygen concentration	O ₂ conc.
CO ₂ end tidal concentration	etCO ₂
CO ₂ minute elimination	VCO ₂
CO ₂ tidal elimination	VT _{CO₂}
Dynamic compliance	C _{dyn}
Static compliance	C _{static}
Inspiratory resistance	R _i
Expiratory resistance	R _e

Work of breathing, ventilator	WOBvent
Work of breathing, patient	WOBpat
Elastance	E
P 0.1	P 0.1
Shallow Breathing Index	SBI
Ratio of expired tidal volume to predicted body weight	VT/PBW
Switch to backup (/minute)	Backup Σ
Backup (%/min)	Backup %
Ratio of tidal volume to predicted body weight <i>Based on VTe</i>	VT/PBW
Switch to backup (/minute)	Backup Σ
Backup (%/min)	Backup %
Stress Index	SI

10 Aerogen nebulizer

10.1 Aerogen Solo nebulizer

Aerogen Solo nebulizer	
Weight	Approximate 13.5 g
Dimensions	W 48 x L 25 x H 67 mm
Operating temperature	10°C to 38°C
As measured with the Anderson Cascade Impactor:	
Specification range	1 - 5 μm .
Average tested	3.1 μm
As measured with the Marple 298 Cascade Impactor:	
Specification range	1.5 - 6.2 μm .
Average tested	3.9 μm
Flow rate	>0.2 (average: ~0.38) ml/min
Max volume, medication cup	6 ml
Residual volume	<0.1 ml for 3 ml dose
Control cable	1.8 m
Lifetime	- Intermittent use a maximum of 28 days based on a typical usage profile of four treatments per day. - Continuous use a maximum of 7 days. Do not exceed the recommended usage time.

11 CO₂ analyzer

General - CO ₂ analyzer	
Measured parameters	- CO₂ End Tidal Concentration - CO₂ Minute Elimination - CO₂ Tidal Elimination The End Tidal CO₂ Concentration is measured as the maximum CO₂ concentration during the expiration.
Measuring method	Mainstream, dual-wavelength, non-dispersive infrared.
Oxygen concentration compensation	Automatic. Values supplied from the ventilator system
Barometric pressure compensation	Automatic. Values supplied from the ventilator system

CAPNOSTAT 5 - CO ₂ analyzer	
Size	Sensor: 32.0 x 47.0 x 21.6 mm
Weight	- Sensor: 20 g - Airway adapter: 10 g
Sensor cable	2.8 m
Measuring range	0 to 100 mmHg CO₂ partial pressure 0 to 13.3 kPa CO₂ partial pressure 0 to 13.2 % CO₂ volume (at a barometric pressure of 1013 hPa)
Warm-up time	15 s to initial CO ₂ indication maximum 2 minutes to full specification
Digitizing rate	100 Hz
Airway adapter dead space	- Pediatric: <1 cm³ - Adult: <6 cm³

12 Communication/interface

Communication/interface	
Serial ports	Isolated RS-232C. For data communication via the Servo Communication Interface (SCI) Information regarding connector wiring is available from the manufacturer.
Servo Communication Interface (SCI)	A protocol for data communication with external devices
Alarm output connection (option)	Isolated 4-pin modular connector for communication of all active alarms Switching capability: Max 40 V DC, Max 500 mA, Max 20 W Information regarding connector wiring is available from the manufacturer.
Data Transfer via USB port	Non-isolated For transfer of trends, logs, screen shots and recordings to a USB memory stick

13 Accessories

To avoid instability, load the ventilator equipment symmetrically on the ventilator system.

Mobile cart (option)	
Weight	15.0 kg
Dimensions	W 647 x L 547 x H 860 mm

Storage bin (option)	
Weight	0.9 kg
Dimensions	W 331 x L 223 x H 104 mm
Load weight	2.5 kg

Humidifier holder (option)	
To avoid instability, mount the humidifier holder in the front part of the carrier.	
Weight	0.5 kg
Dimensions	W 76 x L 125 x H 140
Maximum load	5 kg (excluding water bag/IV pole)

Water bag/IV pole (option)	
Weight	0.4 kg
Dimensions	W 148 x L 26 x H 1007
Maximum load	1.5 kg

Support arm 179 (option)	
Weight	1.9 kg
Dimensions	Length 900 mm
Maximum load	0.5 kg

Gas cylinder restrainer kit (option)	
Weight	1.0 kg
Dimensions	Upper: W 104 x L 65 x H 48 Lower: W 106 x L 162 x H 76
Maximum load	Two 8 kg bottles

Shelf base (option)	
Make sure that the shelf base is securely fixed on the table or shelf.	
Weight	3.0 kg
Dimensions	W 340 x L 270 x H 43

Y piece holder (option)	
Dimensions	W 42 x L 52 x H 46

Cable holder for handle (option)	
Weight	0.1 kg
Dimensions	W 138 x L 92 x H 155
Maximum load	2.5 kg

Other accessories (option)	
Expiratory heater, Servo Duo Guard	Refer to the Expiratory heater, Servo Duo Guard User's Manual.
Servo Duo Guard	Refer to the Servo Duo Guard User's Manual.
Servo Guard	Refer to the Servo Guard User's Manual.
Fisher & Paykel Healthcare, MR850 Respiratory humidifier	Refer to the Fisher & Paykel Healthcare, MR850 Respiratory humidifier User's Manual.
Fisher & Paykel Healthcare, MR810 Respiratory humidifier	Refer to the Fisher & Paykel Healthcare, MR810 Respiratory humidifier User's Manual.
Fisher & Paykel Healthcare, F&P 950 Respiratory humidifier	Refer to the Fisher & Paykel Healthcare, F&P 950 Respiratory humidifier, User instructions.

Refer to Servo-air system flowchart for information regarding use of accessories to be used with the ventilator system.

14 Logs

14.1 Event log

The following events are logged:

- Activation/deactivation of clinical alarms
- Ventilator settings
- Apnea periods
- Manual breath
- O₂ boost
- Activation/deactivation of circuit compensation

14.2 Diagnostic log

The following items are logged:

- Technical information
- Test results
- Service records
- Software installation
- Configuration information

15 Service

Preventive maintenance must be performed by authorized personnel at least once every 5000 hours of operation or once every 12 months, whichever comes first.