Datasheet
SERVO-n

GETINGE GROUP

System version 2.1

This document is intended to provide information to an international audience outside of the US.

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Technical specifications
SERVO-n

General	
Intended use	The SERVO-n ventilator system is: • intended for respiratory support, monitoring and treatment of neonatal and pediatric patients • to be used only by healthcare providers • to be used only in professional healthcare facilities and for transport within these facilities For NAVA and Edi monitoring, it is in addition intended: • to provide monitoring of the patient's breathing drive • to improve synchrony between the ventilator system and patient when the electrical signal from the brain to the diaphragm is active • for use on all patients with no contraindication for insertion/exchange of a nasogastric tube
Instructions for use	Please carefully read the user's manual
Legal manufacturer	Maquet Critical Care AB
Other products	See separate datasheets. Contact your local Getinge supplier for more information.

The ventilator—General	SERVO-n	SERVO-n on mobile cart
Base system weight	Approximately 23 kg (50.7 lbs) • Patient unit 15 kg (33.0 lbs) • User interface 4 kg (8.8 lbs) • Handle 3 kg (6.6 lbs) • Cable holder and cable 1 k (2.2 lbs)	Approximately 35 kg (77.2 lbs) • Base system approx. 23 kg (50.7 lbs) • Mobile cart 12.5 kg (27.6 lbs)
Dimensions of base (W x D), see dimensional drawings on page 19.	368 x 205 mm (14.5" x 8.1")	647 x 547 mm (25.5" x 21.5") incl. wheels
Height (incl. user interface)	826 mm (32.5")	1368 mm (53.8")
Wheels	N/A	Four wheels with separate brakes
A-weighted sound pressure level (L_{PA})	<40 dB, measured at a distance of 1 m (3.3 ft)	
A-weighted sound power level (L_{WA})	<51 dB	

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Ventilation—General	
Patient range	• Neonatal: 0.3—8 kg (0.7—17.6 lbs) • Pediatric: 3—30 kg (6.6—66.0 lbs)
Bias flow	0.5 l/min
Internal compressible factor	Max. 0.1 ml/cmH_2O
Gas delivery system	Microprocessor controlled valves
Maximum airway pressure	125 cmH_2O
Method of triggering	Flow, pressure and Edi (with Edi module and Edi catheter)
Inspiratory flow range	0 to 33 l/min
Pressure drop	• Max. 6 cmH_2O at a flow of 60 l/min (insp. channel) • Max. 3 cmH_2O at a flow of 60 l/min (exp. channel)
PEEP regulation	Microprocessor controlled valve
Rise time, expiratory flow measurement	<12 ms for 10—90 % response at flow of 3—192 l/min
Expiratory flow range	0 to 192 l/min

User interface	
Type	TFT-LCD touchscreen
Size	366 x 300 x 50 mm (14.4" x 11.8" x 2.0")
Viewing area	15" XGA, 1024 x 768 pixels with a 24-bit color palette
Weight	Approximately 4 kg (8.8 lbs)

Technical specifications
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Power supply	
Power supply, automatic range selection	• 100—120 V AC, 2 A, 50—60 Hz • 220—240 V AC, 1 A, 50—60 Hz
Plug-in battery module Battery backup (nickel-metal hydride, NiMH) Battery capacity Battery backup time Recharge time	 Six battery module slots. Two batteries are delivered with the ventilator. Rechargeable, 12 V, 3.5 Ah each Ranging from 60 minutes (2 batteries) to 180 minutes (6 batteries) Approximately 3 h/battery
External 12 V DC	12.0 V—15.0 V DC, 10 A
Typical min. power consumption (no optional modules, no ongoing battery charging, normal panel backlight)	100 VA, 40 W at 230 V or 75 VA, 40 W at 110 V
Typical max. power consumption (with CO_2), Edi and Y sensor modules, ongoing battery charging, max. panel backlight)	200 VA, 80 W at 230 V or 170 VA, 80 W at 110 V

Gas supply	
Inlet gas pressure air/O_2	200—600 kPa / 2.0—6.0 bar / 29—87 PSI
Connection standards available	AGA, DISS, NIST, or French standard
Unavailable gas/loss of gas pressure	The flow from an unavailable gas (air or O_2) is automatically compensated for so that the patient gets the preset volume and pressure.
Patient system gas connectors	Male 22 mm / female 15 mm. In accordance with ISO 5356-1
Gas exhaust port	Male 30 mm cone

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Operating conditions	
Temperature	10 to 40 °C (50 to 104 °F)
Relative humidity	15 to 95% non-condensing
Atmospheric pressure	660 to 1060 hPa
Lowest pressure in patient circuit	–400 cmH_2O

Non operating conditions	
Temperature	–25 to +60 °C (–13 to 140 °F)
Relative humidity	< 95% condensing
Atmospheric pressure	470 to 1060 hPa
Lowest pressure in patient circuit	N/A

Standards—Safety and Functionality	
CE 0123	The device complies with requirements and classification IIb of Medical Device Directive 93/42/EEC. CE Mark Notified Body number: 0123.
Classification	IEC 60601-1: 2005, Class I, continuous operation
Standards	• ISO 80601-2-12:2011, ISO 80601-2-55:2011, EN 13544-1:2007+A1:2009 • IEC 60601-1, Type B (equipment making physical contact with the patient and the gas pathways). • IEC 60601-1, Type BF (CO_2 analyzer, Y sensor, nebulizer patient unit and cable) • IEC 60601-1, Type CF-defibrillation proof (Edi catheter and cable)
Ingress protection	IP 21
Electromagnetic compatibility (EMC)	• According to limits specified in IEC 60601-1-2: 2007. • The *'EMC Declaration, Information to the Responsible Organization'* is available from Maquet

Technical specifications
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Display	
Views	• Basic view • Advanced view • Loops view • Distance view • Family view • 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 • CO_2 (with CO_2 analyzer option) • Edi (with Edi module and Edi catheter)
Loops	• Pressure—Volume • Pressure—Flow • Volume—Flow A reference loop and three overlaying loops can be displayed.
SERVO COMPASS	Visualizes volume (VT/BW) and pressure (total or driving) in relation to set targets in invasive modes.

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Ventilation modes—Invasive ventilation	
Controlled ventilation	• PC (Pressure Control) • VC (Volume Control) • PRVC (Pressure Regulated Volume Control)
Supported ventilation	• PS/CPAP (Pressure Support / Continuous Positive Airway Pressure) • VS (Volume Support)
Automode (option)	• Control mode: VC <—> Support mode: VS • Control mode: PC <—> Support mode: PS • Control mode: PRVC <—> Support mode: VS
Combined ventilation	• SIMV (VC) + PS (Synchronized Intermittent Mandatory Ventilation) • SIMV (PC) + PS • SIMV (PRVC) + PS • Bi-Vent/APRV (Airway Pressure Release Ventilation)
NAVA	• Neurally Adjusted Ventilatory Assist via endotracheal tube or tracheostomy
VC and SIMV (VC) + PS and Automode VC <—> VS are not available in the neonatal patient category.	

Invasive ventilation		
Max. leakage compensation level	Neonatal	25 l/min

Ventilation modes—Non invasive ventilation	
Controlled ventilation	• NIV PC (option)
Supported ventilation	• NIV PS (option) • Nasal CPAP
NIV NAVA	• Neurally Adjusted Ventilatory Assist via non-invasive patient interfaces
NIV PS is not available in the neonatal patient category	

Non invasive ventilation		
Max. leakage compensation level	Pediatric and neonatal	• Inspiratory: up to 33 l/min • Expiratory: up to 25 l/min • Nasal CPAP: up to 20 l/min
Disconnection flow (configurable)	Low High Disabled	7.5 l/min 15 l/min Deactivates disconnection detection
Connection detection	Manual or automatic via bias flow	

Technical specifications
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High Flow therapy (option)		
Flow setting range	Pediatric Neonatal	0.5—30 l/min 0.5—20 l/min

Parameter settings	Neonatal range	Pediatric range
Tidal volume (ml)	2—50	10—350
Minute volume (l/min)	0.1—7.5	0.3—20
Apnea, time to alarm (s)	1—45	2—45
Max. apnea time in Automode (s)	3—15	3—15
Pressure level above PEEP (cmH_2O)	0—80	0—80
Pressure level above PEEP in NIV (cmH_2O)	0—60	0—60
PEEP (cmH_2O)	1—50	1—50
PEEP in NIV (cmH_2O)	2—20	2—20
CPAP pressure (cmH_2O)	2—20	2—20
Respiratory rate (breaths/min)	4—150	4—150
SIMV rate (breaths/min)	1—60	1—60
Breath cycle time, SIMV (s)	0.5—15	0.5—15
P_{High} (cmH_2O)	2—50	2—50
T_{High} (s)	0.2—30	0.2—30
T_{PEEP} (s)	0.1—10	0.1—10
PS above P_{High} (cmH_2O)	0—78	0—78
O_2 concentration (%)	21—100	21—100
I:E ratio	1:10—4:1	1:10—4:1
Ti (s)	0.1—5	0.1—5
NAVA level (cmH_2O/µV)	0—15	0—15
Edi trigger (µV)	0.1—2.0	0.1—2.0
T_{Pause} (s)	—	0—1.5
T_{Pause} (% of breath cycle time)	—	0—30
Flow trigger (l/min)	0—0.5	0—0.5
Pressure trigger (cmH_2O)	–1 to –20	–1 to –20
Insp. rise time (% of breath cycle time)	0—20	0—20
Insp. rise time (s)	0—0.2	0—0.2
End inspiration (% of peak flow)	1—70	1—70
End inspiration (% of peak flow) in NIV	10—70	10—70

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Backup parameter settings	Neonatal range	Pediatric range
Inspiratory tidal volume (ml)	2—50	10—350
Pressure level above PEEP in backup (cmH_2O)	5—80	5—80
Pressure level above PEEP in NIV backup (cmH_2O)	5—60	5—60
Respiratory rate in backup (breaths/min)	4—150	4—150
I:E ratio	1:10—4:1	1:10—4:1
Ti (s)	0.1—5	0.1—5

Special functions	Setting range
Manual breath	Initiation of 1 breath (In SIMV mode initiation of 1 mandatory breath)
Static measurements	Insp. or exp. hold (0—30 seconds)
Nebulization	5—30 min/Continuous/Off
O_2 boost level	Off, 1—79 %
O_2 boost function	Activate O_2 boost up to 1 minute
Leakage compensation	On/Off
Circuit compensation	On/Off
Edi monitoring	In all ventilation modes and in Standby (with Edi module and Edi catheter)
Previous mode	Activates previously used mode
Backup ventilation	Backup On/Off
Apnea management	Several parameters

Disconnection/Suction	
Pre-oxygenation time	Max. 2 min
Post-oxygenation time	Max. 1 min
Patient disconnected	High priority alarm activated after 1 min
Adjustable oxygen level	21—100 %

Technical specifications
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Monitoring and trends	
Peak airway pressure	Ppeak
Pause airway pressure	Pplat
Mean airway pressure	Pmean
Driving pressure	Pdrive
Positive end expiratory pressure	PEEP
Continuous positive airway pressure	CPAP
Spontaneous breaths per minute	RR sp
Respiratory rate	RR
Spontaneous expiratory minute volume	MVe sp
Inspired minute volume	MVi
Expired minute volume	MVe
Leakage fraction (%)	Leakage
Inspired tidal volume	VTi
Expired tidal volume	VTe
End expiratory flow	Flowee
Measured oxygen concentration	O_2 conc
CO_2 end tidal concentration	etCO_2
CO_2 minute elimination	VCO_2
CO_2 tidal elimination	VTCO_2
Dynamic compliance	Cdyn
Static compliance	Cstatic
Inspiratory resistance	Ri
Expiratory resistance	Re
Work of breathing, ventilator	WOBvent
Work of breathing, patient	WOBpat
Elastance	E
P 0.1	P 0.1
Shallow Breathing Index	SBI
Peak Edi value	Edipeak
Average Edipeak	Edipeak average (monitoring only)
Average Edimin	Edimin average (monitoring only)
Minimum Edi value	Edimin
Ratio of expired tidal volume to body weight	VT/BW
Switches to backup per minute	Backup ∑ (trended value only)
Time in backup in percent per minute	Backup % (trended value only)

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Alarms	Neonatal range	Pediatric range
Airway pressure (upper alarm limit)	16—90 cmH_2O	16—90 cmH_2O
Airway pressure NIV (upper alarm limit)	16—70 cmH_2O	16—70 cmH_2O
Respiratory rate (upper and lower alarm limits)	1—160 breaths/min	1—160 breaths/min
Expired minute volume (upper alarm limit)	0.02—30 l/min	0.02—30 l/min
Expired minute volume (lower alarm limit)	0.01—20 l/min	0.01—20 l/min
End expiratory pressure (upper alarm limit)	1—55 cmH_2O	1—55 cmH_2O
End expiratory pressure (lower alarm limit)	Off, 1—47 cmH_2O	Off, 1—47 cmH_2O
No patient effort (Apnea) alarm	1—45 s	2—45 s
	Automatic return to support mode on patient triggering	
No consistent patient effort	Yes, described in User's manual	
High continuous pressure	Yes, described in User's manual	
O_2 concentration	Set value ±5 vol% or ≤18 vol%	
Gas supply	Below 200 kPa (2.0 bar/29 PSI), above 600 kPa (6.0 bar/87 PSI)	
Battery	• Limited battery capacity: 10 min. • No battery capacity: less than 3 min. • Low battery voltage.	
End tidal CO_2 (upper and lower limit)	0.5—20 %, 4—100 mmHg, 0.5—14 kPa	
Leakage too high	Yes, described in User's manual	
Technical	Yes, described in User's manual	

Autoset (alarm limits) specification	Invasive ventilation, controlled modes only
High airway pressure	Mean peak pressure +10 cmH_2O or at least 35 cmH_2O
Inspiratory tidal volume too high	The greater of VTi +30 % or VTi +2 ml
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_2O
End expiratory pressure (lower alarm limit)	Mean end expiratory pressure –3 cmH_2O
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 %

Technical specifications
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Optional equipment	Weight	Dimensions	Maximum load
Mobile cart	12.5 kg (27.6 lbs)	W 647 x L 547 x H 557 mm (W 25.5" x L 21.5" x H 21.9")	-
Drawer for mobile cart	0.6 kg (1.3 lbs)	W 247 x L 118 x H 302 mm (W 9.7" x L 4.6" x H 11.9")	-
Shelf base	2.5 kg (5.5 lbs)	W 207 x L 302 x H 43 mm (W 8.2" x L 4.6" x H 1.7")	-
Pendant/bed holder	3.2 kg (7.1 lbs)	W 302 x L 302 x H 393 mm W 11.9" x L 11.9" x H 15.5")	-
Humidifier holder	0.5 kg (1.1 lbs)	W 243 x L 38 x H 185 mm (W 9.6" x L 1.5" x H 7.3")	5 kg (11.0 lbs)
Support arm 178	2.5 kg (5.5 lbs)	L 900 mm (35.4")	1—3 kg (2.2—6.6 lbs) depending on angle
User interface holder	0.6 kg (1.3 lbs)	W 46 x L 90 x H 123 mm (W 1.8" x L 3.5" x H 4.8")	-
Cable holder for handle	0.1 kg (0.2 lbs)	W 138 x L 92 x H 155 mm (W 5.4" x L 3.6" x H 6.1")	5 kg (11.0 lbs)
Waterbag/IV pole	0.4 kg (0.9 lbs)	W 148 x L 26 x H 1007 mm (W 5.8" x L 1.0" x H 39.6")	1.5 kg (3.3 lbs)
Gas cylinder restrainer kit	0.5 kg (1.1 lbs)	Upper: W 104 x L 65 x H 48 mm (W 4.1" x L 2.5" x H 1.9") Lower: W 106 x L 162 x H 76 mm (W 4.1" x L 6.4" x H 3.0")	Two 4.5-liter bottles
Y piece holder		W 26 x L 52 x H 46 mm (W 1.0" x L 2.0" x H 1.8")	

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Y sensor (option)	Size	Weight
Y sensor module	W 154 x L 90 x H 21 mm (W 6.1" x L 3.5" x H 0.8")	280 g (0.6 lbs)
Y sensor	W 18 x L 50 x H 27 mm (W 0.7" x L 2.0" x H 1.1")	11 g
Connectors and cables	• 15 mm male and female conical connector on flow sensor according to ISO 5356-1 • Pressure port on module, pressure line, 2.0 m (6.6 ft), phthalate free PVC • Flow sensor cable, 2.0 m (6.6 ft)	
Sensor material	• Single use: PC, Polycarbonate • Reusable: PEI, Polyetherimide or PSF, Polysulfone	
Power source	Powered by the ventilator system, 4.5 W during normal operation.	
Measuring method	Hot Wire Anemometer (HWA)	
Parameters	• Airway pressure. • Airway flow. • Inspiratory and expiratory volumes. • Trigger and End inspiration	
Measuring range	• Flow: 0.12 to 32 l/min • Pressure: –40 to 120 cmH_2O	
Y sensor resistance	10 cmH_2O/l/s at 30 l/min	
Dead space	≤1 ml	
Pressure line connector	Gable mounted bulk head connector to fit tubing with an inner diameter of 3—4 mm (0.12—0.16").	

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CO_2 analyzer (option)	Size	Weight
CO_2 analyzer module	W 154 x L 90 x H 43 mm (W 6.1" x L 3.5" x H 1.7")	0.45 kg (1.0 lbs)
Sensor (Capnostat 5)	32.0 x 47.0 x 21.6 mm (1.3" x 1.9" x 0.8")	20 g
Operating temperature	10 °C to 33 °C	
Airway adapter		10 g
Power source	Powered by the ventilator	
Connectors and cables	Sensor	2.8 m (9.2 ft) cable
Measuring method	Mainstream, dual-wavelength, non-dispersive infrared	
Parameters	• CO_2 end tidal concentration ($etCO_2$) • CO_2 minute elimination (VCO_2) • CO_2 tidal elimination ($VTCO_2$)	
Measuring range	• 0 to 100 mmHg CO_2 partial pressure • 0 to 13.3 kPa CO_2 partial pressure • 0 to 13.2 % CO_2 volume (at a barometric pressure of 1013 hPa)	
System response time CO_2	The total system response time of the CO_2 monitor when exposed first to air and then to a gas mix with 5.0 % CO_2 is <250 ms.	
Warm-up time	15 s to initial CO_2 indication maximum 2 minutes to full specification	
Oxygen concentration compensation	Automatic. Values supplied from the ventilator system	
Barometric pressure compensation	Automatic. Values supplied from the ventilator system	
Digitizing rate	100 Hz	
Airway adapter dead space	Neonatal/pediatric	<1 cm^3

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Edi module (option)	Size	Weight
Edi module	W 154 x L 90 x H 21 mm (W 6.1" x L 3.5" x H 0.8")	0.25 kg (0.6 lbs)
Edi catheter cable	2.0 m (6.6 ft)	-
Power source	Powered by the ventilator	
Power consumption	<3 W during normal operation	
Parameters	• Edi waveform • ECG leads waveforms • NAVA estimated pressure waveform (Pest)	

Aerogen nebulizers	Pro	Solo
Size	W 50 x L 50 x H 45 mm (W 2.0" x L 2.0" x H 1.8")	W 48 x L 25 x H 67 mm (W 1.9" x L 1.0" x H 2.6")
Weight	Approx. 25 g	Approx. 14 g
Particle size	1—5 µm mass median aerodynamic diameter (MMAD)	
Flow rate	>0.2 (average: ~0.4) ml/min	
Max. volume	10 ml	6 ml
Residual volume	<0.1 ml for 3 ml dose	
Control cable	1.8 m (5.9 ft)	

Technical specifications
SERVO-n

Communication/Interface	
Serial ports	• Isolated • Two RS-232C ports. For data communication via the Servo Communication Interface (SCI).
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.
Data transfer via USB port	• Non-isolated • For transfer of trends, logs, screenshots and recordings to a USB memory stick
VGA port	• Non-isolated • External monitors should be isolated from the ventilator system. This can be achieved if the connected monitor is powered via a medical grade transformer. • The secondary monitor output is not to be relied on for alarms.
Ethernet port	• Isolated • The network connection (LAN) port is for service use, and should only be used by personnel trained and authorized by Maquet.
MSync, HL7 converter (optional)	See separate datasheet.

Technical specifications
SERVO-n

Log function	
Event log	• Alarms • Ventilator settings • Apnea periods • Immediate functions
Diagnostic log	• Technical information • Test results • Service records • Software installation • Configuration information

Saving of data	
Recording of current waveform and parameter values	30 seconds of data will be recorded (15 seconds before and 15 seconds after activation). Up to 40 recordings can be stored
Saving screenshots	Up to 40 screenshots can be stored
Export files	Recordings, screenshots and the event log can be saved together in an export file and transferred to a USB memory stick

Compressor Mini (option)
See separate datasheet

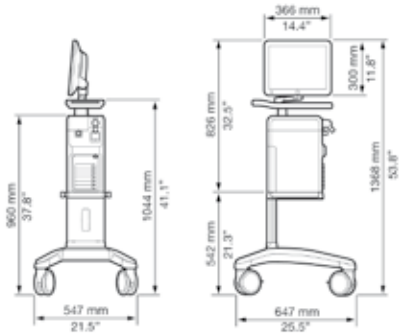
Service	
Regular maintenance	Once every 12 months or at least after 5000 operating hours

Ordering information
SERVO-n, ventilator system and accessories: See separate information in “System flowchart, Ventilation, SERVO-n”, art no 68 85 739.

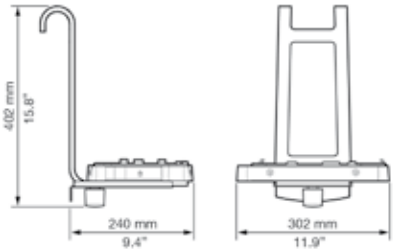
Technical specifications
SERVO-n

Dimensional drawings

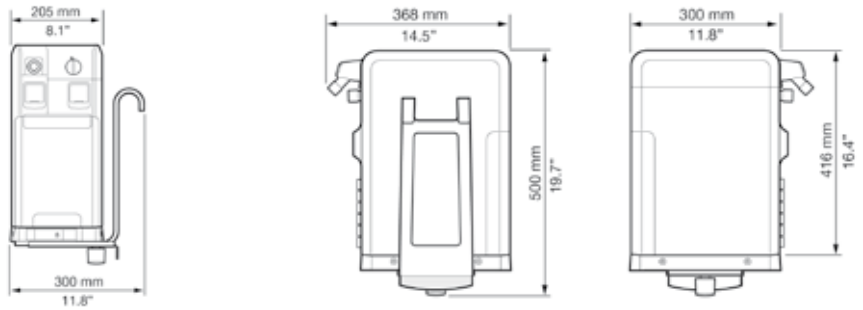
SERVO-n on mobile cart



SERVO-n holder



SERVO-n (patient unit) on SERVO-n holder



SERVO-n may be pending regulatory approvals to be marketed in your country. Contact your Getinge representative for more information.

This document is intended to provide information to an international audience outside of the US.

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Getinge Group is a leading global provider of innovative solutions for operating rooms, intensive-care units, hospital wards, sterilization departments, elderly care and for life science companies and institutions. With a genuine passion for life we build quality and safety into every system. Our unique value proposition mirrors the continuum of care, enhancing efficiency throughout the clinical pathway. Based on our first-hand experience and close partnerships, we are able to exceed expectations from customers – improving the every-day life for people, today and tomorrow.

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