

1. Anesthesia system

Physical Specifications

Dimensions and Weight

Height	1490 mm
Width	910 mm
Depth	705 mm
Weight	160 kg (with AG module and 3 yokes, without vaporizers and gas cylinders)

Work Surface

Height	850 mm
Width	590 mm
Depth	325 mm
Weight limit	30 kg

Drawer (3 drawers, Internal Dimension)

Height	140 mm
Width	420 mm
Depth	315 mm
Weight limit	5 kg

Bag Arm

Height	1130 mm
Length	312 mm
Swiveling angle	120 degrees

Casters

Diameter	12.5 cm
Brake	Centre brake system with Lock/Unlock icon
Cable pusher	cable pusher wish each caster

Side mounting GCX Rails

Upper left length	130 mm
Upper right length	180 mm
Lower right length	485 mm
Supporting weight	27 kg at a maximum distance of 0.41 m

Work Light

Settings	OFF, Low, High
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Main Screen

23.2. Display size 18.5 inch 46.99 cm.

23.1. Display type Color LCD with capacitive touch screen

Resolution 1920 x 1080

2.2. Rotated 360 degrees 23.4.

Tilted 60 degrees

Display parameters All setting and alarm parameters (including Breath rate, I/E ratio, Tidal volume, Minute volume, PEEP, MEAN, PEAK, PLAT, and O₂ concentration, EtCO₂, N₂O, Aesthesia gas concentration, BIS)

Graphic waveforms Pressure, Flow, Volume, CO₂, O₂, Anesthetic gas, N₂O, BIS, Pes, Ptp

24. Up to 5 waveforms display simultaneously

28. Spirometry loops Pressure-Volume, Flow-Volume and Pressure-Flow

Timer Display on screen timer

System status display

Display size	8.4 inch
Display type	Color LCD
Resolution	800 x 600
Display content	Volume exchanger indicator, gas supply pressure, vaporizer status, AGSS status

Ventilator Specifications

Modes of Ventilation

Manual/Spontaneous ventilation/Bypass

19.1. Volume Control Ventilation (VCV) with PLV function

19.2. Pressure Control Ventilation (PCV)

19.5. Pressure Control Ventilation with volume guarantee (PCV-VG)

19.6. Continuous Positive Airway Pressure/Pressure Support Ventilation with apnea backup (CPAP/PS)

19.7. Pressure Support Ventilation (PS) with apnea backup

Synchronized Intermittent Mandatory Ventilation

19.3. (SIMV-Volume Controlled and SIMV-Pressure Controlled) 19.4.

19.5. Synchronized Intermittent Mandatory Ventilation Volume Guarantee (SIMV-VG)

Airway Pressure Release Ventilation (APRV)

Adaptive Minute Ventilation (AMV)

Compensation

Circuit gas leakage compensation and automatic compliance compensation

Ventilation Parameters Range

1. Patient type	Adult, Pediatric, Neonate
22.1. Tidal volume	10 to 2000 mL (VCV, SIMV-VC)
	5 to 2000 mL (PCV-VG, SIMV-VG)
	With TV/IBW indicator
22.6. P _{insp}	5 to 90 cmH ₂ O
Plimit	5 to 100 cmH ₂ O
ΔP _{supp}	0, 3 to 60 cmH ₂ O (CPAP/PS)
22.2. Respiration rate	2 to 100 bpm
22.3. I:E	4:1 to 1:8
T _{pause}	OFF, 5% to 60%
22.4. T _{insp}	0.2 to 10.0 s
Trigger window	5% to 90%
22.7. Flow trigger	0.2 to 15 L/min
Pressure trigger	-20 to -1 cmH ₂ O
Exp%	5% to 80%
Min rate	2 to 60 bpm
T _{slope}	0.0 to 2.0 s
Apnea I: E	4:1 to 1:8
ΔP _{apnea}	3 to 60 cmH ₂ O
Phigh	3 to 90 cmH ₂ O
Plow	3 to 50 cmH ₂ O
Thigh	0.2 to 10.0 s
Tlow	0.2 to 10.0 s
MV%	25% to 350%
Positive End Expiratory Pressure (PEEP)	
Type	Integrated, electronic controlled
Range	0 to 50 cmH ₂ O
Monitoring Parameters	
Tidal volume	0 to 3000 ml 30.2.
Minute volume	0 to 100 L/min 30.1.
Minute volume leakage	0 to 10.0 L/min
Peak pressure	-20 to 120 cmH ₂ O 30.4.
Mean pressure	-20 to 120 cmH ₂ O 30.6.
Plateau pressure	-20 to 120 cmH ₂ O 30.5.
I:E	50:1 to 1:50



30.3.	Rate	0 to 150 bpm
30.7.	PEEP	0 to 70 cmH ₂ O
30.8.	Resistance (R)	0 to 600 cmH ₂ O/(L/s)
	Compliance (C)	0 to 300 ml/cmH ₂ O
	Driving Pressure	0 to 120 cmH ₂ O
30.9.	Elastance (E)	0.003 to 10 cmH ₂ O /mL
	Mechanical Power	0.00 to 100.00 J/min
	Inspired oxygen (FiO ₂)	18% to 100%
	Control Accuracy	
	Volume delivery	≤60 ml: ± 10 ml >60 ml and ≤ 210 ml: ±15 ml >210 ml: ±7 % of the set value
	Pressure delivery	± 2.0 cmH ₂ O or ± 7% of the set value, whichever is greater
	PEEP	± 2.0 cmH ₂ O or ± 7% of the set value, whichever is greater
	Monitoring Accuracy	
	Volume monitoring	≤60 mL: ± 10 mL >60 and ≤210 mL: ± 15 mL >210 mL: ± 7% of the reading
	Pressure monitoring	± 2.0 cmH ₂ O or ± 4% of the reading, whichever is greater
	Rate	± 1bpm or ± 5% of the reading, whichever is smaller
	MV	± 0.1L/min or ± 8% of the reading, whichever is greater
	Alarm Setting	
	Paw High	2 to 100 cmH ₂ O
	Paw Low	0 to (Paw High – 2) cmH ₂ O
	TV High	5 to 2200 mL
	TV Low	OFF, 0 to 2195 mL
	MV High	0.2 to 100 L/min
	MV Low	0 to 15 L/min: 0 to (MV High-0.2) L/min 15 to 100 L/min: 15 to (MV High – 1) L/min
	FiO ₂ High	20% to 100%, OFF
	FiO ₂ Low	18 to (FiO ₂ High – 2) %
	Apnea alarm	No breath has been detected within the apnea time.
	Apnea delay time	5 to 60 s (by volume or pressure) 10 to 40 s (by CO ₂ waveform)
	Lung Recruitment Tool	
	Multi-step recruitment (Increasing PEEP progressively)	
	Control parameters	a maximum of 7 steps Δpsupp, PEEP, Breaths, I:E, Rate PEEP on exit
	Preset procedure	up to 5
	One-step recruitment (sustain inflation)	
	Control parameters	Pressure Hold, Hold Time, PEEP on exit
	Cycle Interval	OFF, 1 - 180 min
	Insp Hold & Exp Hold	
	Insp Hold Measurement	Cstat, Pplat, Ri
	Exp Hold Measurement	PEEPi, PEEPtot
	Auxiliary Pressure Monitoring	
	Monitor waveform	Ptp, Pes
	Monitor parameter	Ptpl, PtpE, ΔPtp, PesI, PesE, ΔPes
	Data Storage and Recording	
	Configuration storage	up to 10 customized profiles
	Log storage	10000 entries of alarm and activity logs
	History trend	48 hours of continuous trend data
	Screenshot	up to 50
	Pre-use system check	
	Fully automatic performed by system, including hardware, flowmeter, gas supply, power supply, module, breathing circuit leakage and compliance, vaporizer and AGSS	

5.	Pneumatic Specifications	
	Pipeline Supply	
	Gas type	O ₂ , N ₂ O and Air
4.	Pipeline input range	280 to 600 kPa (40 to 87 psi)
	Pipeline connections	DISS or NIST
	Pipeline Supply Pressure Monitoring	
	Display type	Electronic
	Ranges	0 to 1000kPa (0 to 140 psi)
	Accuracy	± (4% of the full scale reading + 8% of the actual reading)
	Cylinder Supply	
	Cylinder supply	E Cylinder (American style or UK style)
	O ₂ input range	6.9 to 20 MPa (1000 to 2900 psi)
	N ₂ O input range	4.2 to 6 MPa (600 to 870 psi)
	Air input range	6.9 to 20 MPa (1000 to 2900 psi)
	Cylinder connections	Pin-Index Safety System (PISS)
	Yoke configuration	O ₂ , N ₂ O, Air
	Cylinder Supply Pressure Gauges	
	Display type	Mechanical or Electronic
	Air range	0 to 25 MPa (0 to 3500 psi)
	O ₂ range	0 to 25 MPa (0 to 3500 psi)
	N ₂ O range	0 to 10 MPa (0 to 1400 psi)
	Accuracy	± (4% of the full scale reading+8% of the actual reading)
	Ventilator Performance	
	Peak gas flow	180 L/min + Fresh Gas Flow
	ACGO (Auxiliary Common Gas Outlet)	
	Control type	Mechanical
	Safety pressure	A relief valve limits fresh gas pressure at ACGO outlet port to not more than 12.5 kPa
	O₂ Flush	
15.	Flow rate	35 to 50 L/min
35.	Auxiliary O₂ & Air Flowmeter	
	Flow range	0 to 15 L/min
	Oxygen concentration	21 % to 100 %
	Indicator	Glass tube and LED display
	High Flow Nasal Cannula	
	Flow range	2 to 100 L/min
	Oxygen concentration	21 % to 100 %
	Indicator	Glass tube and LED display
	Auxiliary High Pressure O₂ Outlet	
	Pressure range	280 to 600 kPa
	Maximum flow	≥ 90 L/min
	O₂ Controls	
	Supply failure alarm	≤ 220 kPa
	Anesthetic Gas Scavenging System (AGSS)	
	Type of disposal system	Passive Active: High-flow or low-flow
	Pump rate	75 to 105 L/min (High-flow) 25 to 50 L/min (Low-flow)
	Management	Scavenging flow rate monitoring and alarm Automatically switch off when standby
	Venturi Suction Regulator	
	Supply	Air, from system gas source
	Maximum vacuum	≥72 kPa at supply gas pressure of 280 kPa ≥73 kPa at supply gas pressure of 600 kPa
	Maximum flow	≥25 L/min with pipeline gas at 280 kPa ≥32 L/min with pipeline drive gas at 600 kPa
	Continuous Suction Regulator	
	Supply	External vacuum
	Maximum vacuum	517.5 mmHg to 540 mmHg (69 kPa to 72 kPa) with external vacuum applied of 540 mmHg and 40 L/min free flow
	Maximum flow	39 L/min to 40 L/min with external vacuum applied of 540mmHg and 40 L/min free flow

6. Electronic Flow control system (Electronic Mixer)

Direct Flow Control Mode

12. O ₂ flow range	0, 0.2 to 15 L/min
Air flow range	0 to 15 L/min
N ₂ O flow range	0 to 12 L/min
O ₂ flow accuracy	± 50 ml/min or ± 5% of setting value, whichever is greater
Balance gas (Air/N ₂ O) flow accuracy	± 50 ml/min or ± 5% of setting value, whichever is greater

Total Flow Control Mode

13. Total flow range	0, 0.2 to 20 L/min
Total flow accuracy	± 100 ml/min or ± 5% of setting value, whichever is greater

O₂ concentration

Range	21% to 100% (The balance gas is Air) 26% to 100% (The balance gas is N ₂ O)
Accuracy	± 5% V/V for flows < 1 L/min ± 5% of setting for flows ≥ 1 L/min

Optimizer

Available when AG module is loaded

Flow Pause

The fresh gas flow and ventilation will be paused for 1 minute at default. (Maximum 2 minutes)

Backup Flow Control System

Control Type

Mechanical (Control needle valve and knob)

Flow Range

Control range (O ₂)	1 to 15 L/min
Control range (Air)	0 to 15 L/min

Total flow meter

Range	0 to 15 L/min
Indicator	Flow tube
Indicator accuracy	± 10% of the indicated value for flows (between 10% and 100% of full scale with oxygen)

Breathing System Specification

Breathing system volume

Automatic ventilation	1800 ml
Manual ventilation	1950 ml

CO₂ Absorber Assembly

Absorber capacity	1500 ml
Absorber type	1 Pre-Pak canister or Loose Fill absorbent

Inspiratory Airway Pressure Gauge

Range	-20 to 100 cmH ₂ O
Accuracy	± (2% of the full scale reading + 4% of the actual reading)

Flow Sensor

Type	Variable orifice flow sensor
Location	Inspiratory and expiratory port

Oxygen Sensor

Type	Galvanic fuel cell
FiO ₂ displayed	18% to 100%
Accuracy	± (volume fraction of 2.5 % + 2.5 % gas level)
Response time	≤ 20 seconds

Breathing System Connectors

Exhalation	22 mm OD / 15 mm ID conical
Inhalation	22 mm OD / 15 mm ID conical
Manual bag port	22 mm OD / 15 mm ID conical

Bag-to-Ventilator Switch

Type	Bi-stable
Control	Switch between manual and mechanical ventilation

17. Adjustable Pressure Limiting (APL) Valve

Type	Manually control with quick relief function and illumination
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Range	Approximately 0 (SP), 5 to 70 cmH ₂ O
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Tactile knob indication ≥ 30 cmH₂O

Breathing Circuit Parameters

System compliance	≤ 2 mL/cmH ₂ O Volume of gas lost due to internal compliance
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Impedance in manual mode ≤ 6 cmH₂O

Impedance in automatic ventilation mode ≤ 6 cmH₂O

Leakage ≤ 50 mL @ 3 kPa

System safety pressure on patient circuit 110 ± 10 cmH₂O

Breathing System Temperature Controller

Breathing system temperature maintained at least 31°C typical at 20°C ambient temperature in normal condition

Materials

All materials in contact with exhaled patient gases are autoclavable up to a maximum temperature of 134°C, except O₂ sensor and mechanical pressure gauge.

All materials in contact with patient gas are latex free.

7. Vaporizers

Anesthetic Agent Delivery

Vaporizer	V90 Electronic injection anesthetic vaporizer
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Support agents	Isoflurane, Sevoflurane, Desflurane
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8. Position 2 positions

Filling system	Safety filling adaptor (Iso, Sev) Saf-T-Fill (Des)
Isoflurane range	0% to 5%
Sevoflurane range	0% to 8%
Desflurane range	0% to 18%
Control accuracy	± 15% of the setting or ± 5% of full scale, which is greater

Dimension

Height	215 mm
Width	75 mm
Depth	185 mm
Weight	3.5 kg
Agent capacity	320 mL
Liquid level	Optical and electronic monitoring

Monitor Modules

Anesthesia Gas (AG) Module

Conformity with standard	ISO 80601-2-55
Measurement mode	Infrared absorption, sidestream
Monitor gases	CO ₂ , O ₂ (Paramagnetic O ₂ module), N ₂ O, and any of the five anesthetic agents: DES, ISO, ENF, SEV and HAL
Warm-up time	< 45 s (ISO accuracy mode) < 10 min (full accuracy mode)
Sample rate	Adu/Ped: 150, 180, 200 ml/min Neo: 100, 110, 120 ml/min
Monitoring range	CO ₂ : 0% to 30% (0.0 to 30 kPa, 0.0 to 226 mmHg) O ₂ /N ₂ O: 0% to 100% HAL, ISO, ENF: 0% to 30.0% SEV: 0% to 30.0% DES: 0% to 30.0%

BIS/BISx4 Module

Conformity with standard	IEC 60601-2-26
BIS, BIS L/ BIS R	0 to 100
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s
Alarm limit	BIS high: 2 to 100 BIS low: 0 to (BIS high - 2)

Calculated parameters SQI/SQI L, SQI R; EMG/EMG L, EMG R; SR/SR L, SR R; SEF/SEF L, SEF R; TP/TP L, TP R; BC/BC L, BC R; sBIS L, sBIS R; sEMG L, sEMG R; ASYM

NMT Module

Conformity with standard

IEC 60601-2-10

Stimulation output

Pulse width: 100, 200, or 300 μ s; monophasic rectangle pulse; Accuracy: $\pm 10\%$

Stimulation current range: 0 to 60 mA in increments of 5 mA
Accuracy: $\pm 5\%$ or ± 2 mA, whichever is greater

Maximum skin resistance: 3 k Ω @ 60 mA, 5 k Ω @ 40 mA

Block recovery OFF, 1, 2, 3, 4, 5 %, 10 %, 20 %, 30 %, 40 %, 50 %, 60 %, 70 %, 80 %, 90 %, 100 %

TOF (Train Of Four) mode

TOF-Ratio (response percentage) : 5 % to 160 %

TOF-Count (number of responses) : 0 to 4

TOF-T1% (response to the first stimulus as percentage of the reference value) : 0 % to 200 %

ST (Single Twitch) mode

ST-Ratio (response percentage) : 0 % to 200 %

DBS (Double-Burst Stimulation) 3.2/3.3 mode

DBS-Ratio (response percentage) : 5 % to 160 %

DBS-Count (number of responses): 0 to 2

PTC (Post-Tetanic Count) mode

PTC-Count (number of responses) : 0 to 20

Anesthesia Function 10.

Automatic controlled anesthesia (ACA)

Control range	EtISO: 0% to 5%	14.1
	EtSEV: 0% to 8%	14.2
	EtDES: 0% to 18%	14.3
	FiO2: 25% to 100%	14.4
	Flow: Min, 0.3 to 6.0 L/min	14.5
Control accuracy	EtAA: ± 0.2 Vol.% or $\pm 5\%$ of the setting, whichever is larger	
	FiO2: ± 3 Vol.% or $\pm 5\%$ of the setting, whichever is larger	
Response time	EtAA: <100s	
	FiO2: <130s (increase); <230s (decrease)	
Stable time	EtAA: <200s	
	FiO2: <140s (increase); <260s (decrease)	

Anesthetic Prediction

Patient type	Height: 150 to 200 cm
	Weight: 40 to 140 kg
	Age: 18 to 90 years old
Anesthetic agents	Desflurane, Isoflurane, Sevoflurane
Prediction trend and waveform	Dynamic short trend waveforms of FIAA, EtAA, FiO ₂ and EtO ₂ in the last 10 min and prediction trend waveforms of FIAA, EtAA, FiO ₂ and EtO ₂ in the next 20 min.
Prediction deviation	EtAA=0: less than volume fraction of 0.05 % EtAA \neq 0: - 20 % to 30 % of the measured EtAA,

or - 5 % to 7.5 % of the vaporizer maximum setting, whichever is greater
EtO₂ : - 10 % to 15 % of the measured EtO₂, or volume fraction of - 5 % to 7.5 %, whichever is greater

Agent Consumption Calculation

Usage speed range	ISO: 0 mL/h to 250 mL/h
	SEV: 0 mL/h to 450 mL/h
	DES: 0 mL/h to 900 mL/h
Accuracy	± 2 mL/h, or $\pm 15\%$ of the reading, whichever is larger
Total usage range	0 to 3000 ml
Accuracy	± 2 mL, or $\pm 15\%$ of the reading, whichever is larger

Electrical Specifications

Main Electrical Power

3.1. Power input	220-240 Vac, 50/60 Hz, 10A max
	100-240 Vac, 50/60 Hz, 10A max
	100-120 Vac, 50/60 Hz, 10A max
Power cord	5 m (length)

Battery Power

3.2. Battery type	Lead-acid, 12 VDC, 32 Ah (2 batteries)
	Run-time New battery: minimum 90 minutes under typical operating conditions
Time to shut down from the first Lower Battery Alarm	5 minutes minimum (new fully-charged battery)
	Battery charge time <12 hours

Auxiliary Electrical Outlets

Number of outlets	4
Output current	3 A for each outlet, 5 A for total

Communication Port

Communication port	RS-232 compatible serial interface (DB9)
Network port	Two RJ-45 network ports
USB port	Four USB ports
Video signal port	One VGA port for inputting the VGA video signal of the main to external display

Environmental Specifications

Operating

Temperature	10 to 40°C
Relative humidity	15% to 95% (noncondensing)
Barometric (Kpa)	70 to 106.7 kPaz

Storage

Temperature	-20 to 60°C for main unit,
	-20 to 50°C for O ₂ sensor
Relative humidity	10% to 95% (noncondensing)
Barometric	50 to 106.7 kPa

Resistance to Ingress of Fluids

Complies with the requirements of clause 11.6.3 in IEC 60601-1 and also the requirements in IEC 60529 for protection against vertically falling water drops equipment (IPX1)

Not all features are for sale in all countries.

Please contact your local Mindray sales representative for the most current information.

www.mindray.com

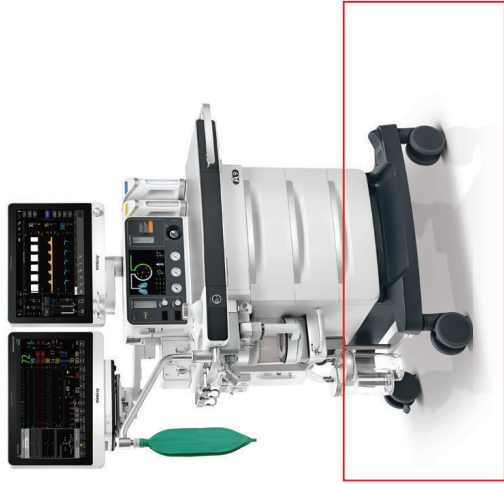
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mindray
healthcare within reach

A9
Anesthesia system

All-round safety



2.2.

Mobili



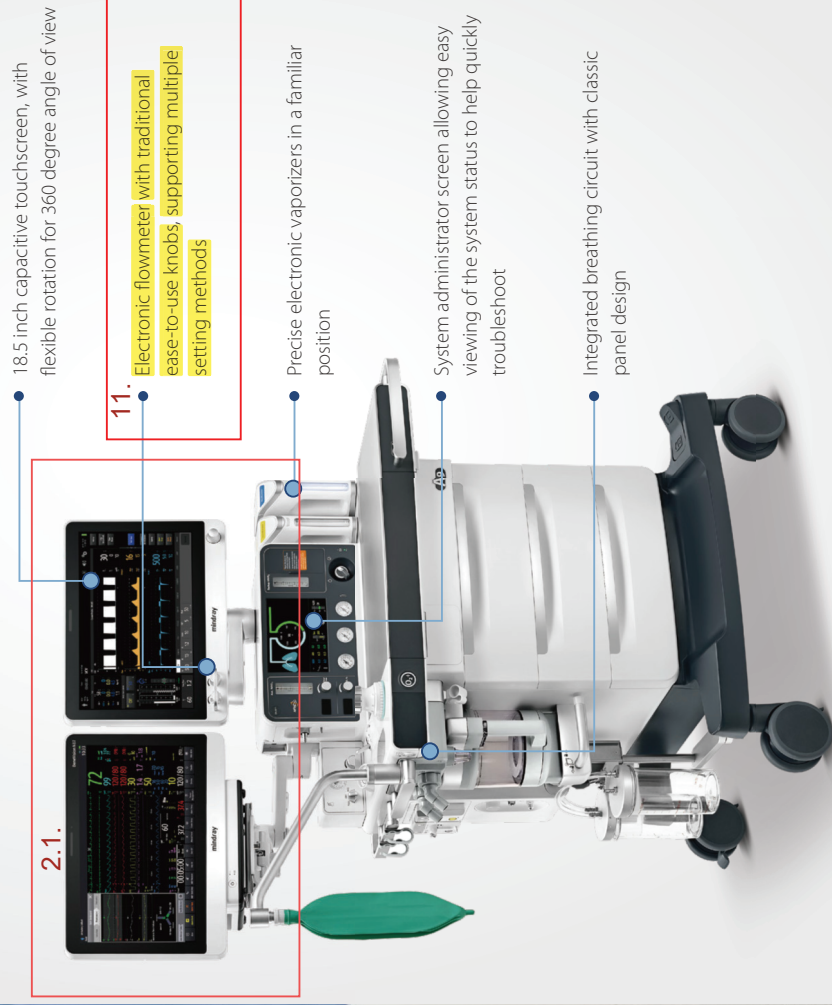
24.4.

36.1.
2.1.



Classic meets high-tech

With appreciation for established ways of working, the A9 retains many traditional features while also introducing some cutting-edge technologies to allow intuitive and safe management of the anesthetic procedure for broad patient populations.



18.5 inch capacitive touchscreen, with flexible rotation for 360 degree angle of view

11.
Electronic flowmeter with traditional ease-to-use knobs, supporting multiple setting methods

Precise electronic vaporizers in a familiar position

System administrator screen allowing easy viewing of the system status to help quickly troubleshoot

Integrated breathing circuit with classic panel design

Introducing the new safety

Mindray's innovative electronic platform on the A9 empowers clinicians to ensure the safety of patients throughout peri-operative periods, from induction to recovery, to improve patient outcomes.

Less is more

With deep insights into the clinical workflow of the operating room, the A9's user interface has been designed around clinicians for reduced workloads and maximum patient safety.

Together, stronger

The A9 provides flexible data integration to meet the demands of various clinical scenarios. Compatible with Mindray patient monitors and third-party clinical information systems, the A9 helps significantly enhance the workflow efficiency in the operating room.





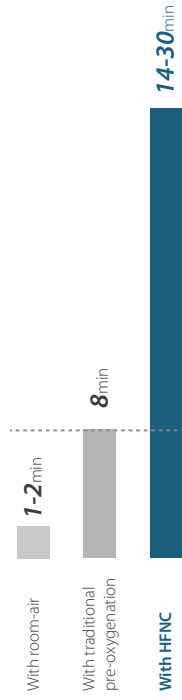
Introducing the new safety

High Flow Nasal Cannula **HFNC**

High flow nasal cannula (HFNC) plays an important role in maintaining safe oxygen saturation of patients as it extends the safe apnoeic oxygenation time to 30min during induction.

HFNC can help clinicians intubate more easily, especially for patients with poor oxygen saturation such as bariatric, pediatric, critical ill or difficult airway.

- Direct setting of total flow and O_2 concentration with maximum flow up to 100L/min.
- Built-in design with no additional gas or power source to remove clutter and save space.
- Quick start-up for emergency situations to improve patient saturation instantly.



The duration of apnoea without desaturation^{[2] [3]}

[2] British Journal of Anaesthesia, 118 (4): 610-7 (2017)
 [3] British Journal of Anaesthesia, 115 (6): 827-48 (2015)

10. 7.

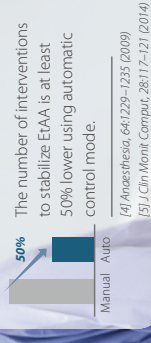
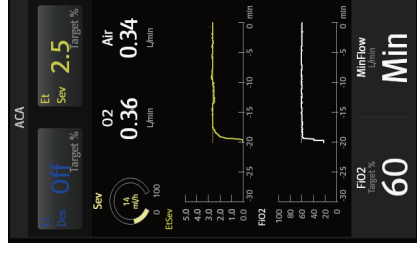
Automatic Controlled Anesthesia (ACA)

ACA is based on A9's new electronic platform that automatically adjusts the fresh gas and vaporizer output to quickly achieve the preset target end-tidal agent and inspiratory oxygen concentration.

- Direct setting of the target EtAA and FI_{O_2} reduces user interaction of fresh gas and vaporizer settings.

- Delivery of fresh gas and agent is adjusted cycle by cycle to rapidly respond to changes in patient status, keeping a stable level of anesthesia during surgery.

- Reduce cost by minimizing the consumption of fresh gas and anesthetic agents throughout the case.





Atelectasis may develop in nearly 90% of patients under general anaesthesia.^[6]
 (6) British Journal of Anaesthesia 91 (1): 61-72 (2003)

Innovative breathing system for ICU-level ventilation

The A9 introduces the volume exchanger (VE) as an innovative breathing system that brings extremely precise and reliable ventilation.

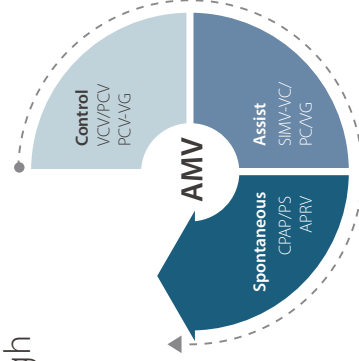
- Quick wash-in & wash-out by small system volume.
- Precise ventilation for all patients; from adults to neonates with tidal volume down to 5 ml.
- Showing the state of breathing system clearly by visual VE indicator.
- Less risk of malfunction with no moving components, providing extremely reliable and a greater service life.



Enjoy maximum performance through all stages of anesthesia

The A9 offers ventilation modes to meet different patient' demands throughout the peri-operative period.

- Adaptive Minute Ventilation Mode (AMV) allows easy switchover between controlled and spontaneous ventilation without extra adjustment.



Powerful protective ventilation toolkits to prevent PPCs

Powerful toolkits have been integrated into the A9 to support confident decision-making for protective ventilation, reducing the incidence of post-operative complications (PPCs) and improving patient outcomes.



Transpulmonary pressure monitoring

Independent monitoring for esophageal pressure, to support customized ventilation settings for individual patient.



Lung Recruitment Tool

Two optional maneuvers: stepwise PEEP or sustained inflation. Multiple criteria to evaluate recruitment effectiveness.
 A scheduled recruitment maneuver can be performed automatically.



TV/IBW indicator

TV/IBW can be calculated as the TV changes, which offers clinicians clear hint of appropriate tidal volume settings to avoid barotrauma.

23.3.



Less is more

Automatic system check



Comprehensive

- Follows the ASA guidelines
- Checks various parts automatically to ensure proper functioning



Fast

- All checks completed in 3.5 minutes
- Scheduled system check to save preparation time



Simple

- No manual intervention required during system check
- Graphic display of error correction


Customizable profiles for smart working

Configuration profiles can be customized and loaded easily for different clinical scenarios or use requirements, including default values, screen layout and system configuration.



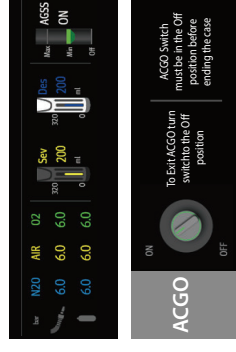
As anesthesiologists look at the monitor in 1- to 2-second glances, displays should be developed to optimize the information.⁷¹

71) *Anesth Analg*, 111 (3): 653-8 (2010)

 **1-2s**

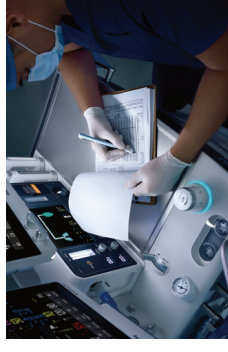
Clear system status indicators

- Real-time system status display to help address malfunctions quickly.
- Clear prompts for certain scenarios, to allow easy viewing of the current working mode.



Light up the workspace

- Illumination around APL valve in manual mode, to make the current working mode more obvious.
- Lighting for workspace with adjustable angles and brightness, to satisfy the requirement for working in low light environments.





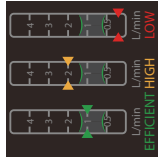
A green operating room

The A9 employs anesthetic gas reduction strategies during surgery to provide both environmental and economic benefits.

7.

Optimizer

A series of clinical decision-support tools including Optimizer, AA Prediction and ACA, can advise clinicians of the lower fresh gas flow.



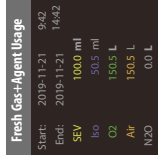
Flow Pause

Flow Pause prevents unnecessary leaks of anesthetic gases into the operating room during intubation, suction and other operations.



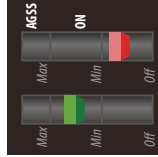
AA measurement

This helps the delivery of low flow anesthesia by monitoring real-time anesthetic agent consumption during and after surgery.



e-AGSS system

e-AGSS monitors the scavenging flow rate and indicates abnormalities; automatically switches off when in standby to reduce energy consumption.



Together, stronger

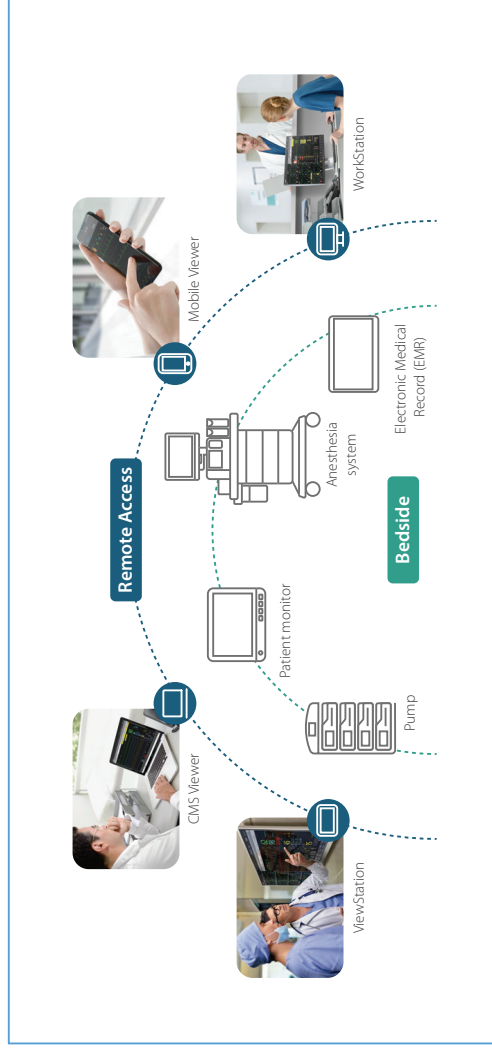
Integration

Highly flexible integration options allow the A9 to work together with a variety of devices, including patient monitors, infusion pumps and information systems, to meet diverse clinical needs.



Connectivity

As a part of the IT solution, the A9 offers information connectivity safety and seamlessly to streamline clinical workflows.



A9

Anesthesia System

Operator's Manual

2.2 Equipment Views

2.2.1 Main Unit (Front View)

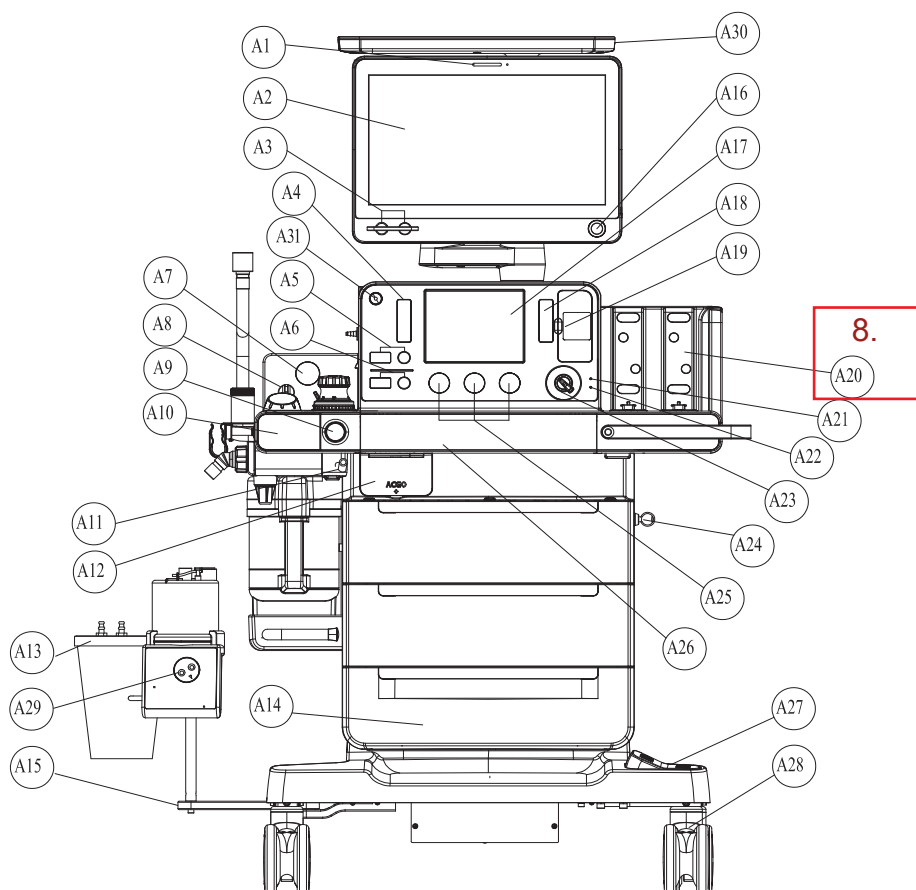


Figure 2-1 Main Unit (Front View)

PARTS	DESCRIPTION
A1 Alarm LED	The alarm LED may turn red, yellow or cyan, indicating different priorities. Red = high priority, yellow = medium priority, cyan = low priority, off = no alarms.
A2 Main Screen	See "System Interface" on Pages 4-1.
A3 The flow or O₂ concentration control knob of the electronic flow control system.	Rotate the knob to adjust the flow or O ₂ concentration.

	PARTS	DESCRIPTION
35.	A4 Auxiliary flowmeter (O₂/air) or High-flow Nasal Cannula Oxygen (HFNC)	There is a float in the flow tube, and the scale line that the middle of the float is aligned to indicates the current gas flow. There is a flow control knob on the flowmeter to control the flow. Rotate the knob counter clockwise to increase the gas flow and rotate the knob clockwise to reduce the gas flow.
	A5 Total flow control knob for auxiliary flow or HFNC	Rotate the knob to adjust the total flow of the auxiliary flowmeter or HFNC.
	A6 Oxygen concentration control knob for auxiliary flow or HFNC	Rotate the knob to adjust the O ₂ concentration of the auxiliary flowmeter or HFNC.
	A7 Negative pressure gauge	Used to indicate the negative pressure.
	A8 Negative pressure suction switch	Used to switch the work mode of the negative pressure suction device. FULL, OFF and REG modes are available. FULL mode indicates that the negative pressure suction device works with the maximum pressure continuously and the control knob is inoperative. OFF mode indicates that the negative pressure is turned off and the negative pressure suction device is inactive. REG mode indicates that the pressure of the negative pressure suction device can be adjusted with the negative pressure control knob. Rotate the knob counter clockwise to increase the negative pressure. Rotate the knob clockwise to reduce the negative pressure.
	A9 O₂ Flush button	Used to provide high-flow O ₂ for the inspiratory branch of the breathing system.
	A10 Oxygen sensor cover	Open the cover to install the O ₂ sensor.
	A11 Negative pressure suction tube clamp	Used to retain the tubes of the negative pressure suction device.
	A12 ACGO (independent outlet and switch)	ACGO switch is used to enable/disable the ACGO feature. ACGO independent outlet is used to output fresh gas.
18.	A13 Negative pressure suction liquid collection bottle	Used to collect the hydrops, hematocele, pus and other contaminants from the patient's pharynx.
	A14 Storage drawers	Three (3) storage drawers (lockable) are available.
	A15 Liquid collection bottle and humidifier bracket	Used to support the negative pressure suction liquid collection bottle and humidifier.
23.3.	A16 Main control knob of display	Press the main control knob to select an item on the menu or confirm the settings. Rotate the knob clockwise or counter clockwise to scroll the items on the menu or change the settings.
	A17 Status display	Used to display the status of gas supply pressure, volume exchanger, AGSS, electronic anesthetic vaporizer and heating module of the breathing system.
	A18 Total flowmeter of Backup Flow Control System	Display the total flow of Backup Flow Control System.
	A19 Backup Flow Control System (BFCS) Cover	Pull the BFCS cover switch outward to start the BFCS. Rotate the flow control knob to control the air and O ₂ flows. Rotate the knob counter clockwise to increase the gas flow and rotate the knob clockwise to reduce the gas flow.
8.	A20 Vaporizer Mount Spot	Used to install and lock the vaporizer. Two vaporizers are supported.
	A21 Battery charging indicator	The indicator is on when the battery is being charged.
	A22 AC status indicator	The indicator is on when the system is connected to an AC power source.
	A23 System switch	Used to switch on or off the system.

2.2.

PARTS		DESCRIPTION
A24	Key lock	The key and lock to lock a drawer.
A25	Gas supply pressure gauge	Used to indicate the inlet pressure of the O ₂ , air and N ₂ O pipelines for the anesthesia system not configured with backup gas cylinders. Used to indicate the pressure of the O ₂ , air and N ₂ O backup gas cylinders for the anesthesia system configured with backup gas cylinders.
A26	Volume exchanger cover	Pull the unlocking button in the bottom right corner outward as per instructions on the equipment to open the volume exchanger cover.
A27	Caster lock	Lock/release the brakes for front two casters when depressed.
A28	Caster	The system moves with the help of casters. Caster lock of the equipment is controlled by the central brake and caster brake.
A29	Humidifier	The humidifier should be connected to the tube when the High-flow Nasal Cannula Oxygen (HFNC) feature is enabled.
A30	Top Shelf	Top shelf surface.
A31	Auxiliary flowmeter (O ₂ /air) or High-flow Nasal Cannula Oxygen (HFNC) switch	Used to switch on or off the auxiliary flowmeter or high-flow nasal cannula oxygen function.

Degree of Protection against Harmful Ingress of Water:	IPX1 (IPX4 for BIS Module)
Electrical Connection between Equipment and Patient:	Electrical connections
Degree of Mobility:	Mobile (including the base and casters)
Disinfection methods:	Steam autoclavable or disinfectable
Application parts with protection against electric shock:	All application parts
Signal input or output part:	Both signal input and output parts
Permanent or non-permanent installation:	Non-permanent installation

TABLE 12-1 Safety Designations

12.3 Physical Specifications

Dimensions:	Height: 1490 mm Width: 910 mm Depth: 705 mm
Weight:	Approximately 160 kg (Standard configured mass) Approximately 290 kg (Maximum configured mass)
Worktable (stainless steel):	Weight limit: 30kg Width: 590 mm Depth: 325 mm Height: 850 mm
Top Shelf:	Weight limit: 15kg Width: 480mm Depth: 310mm

2.2.

Side Mounting Rails:	Supporting weight: 27 kg at a maximum distance of 0.41 m with a safety factor of 6 times the weight
Bag Arm:	Fixed Height Bag Arm: Length: 312 mm Height: 1130 mm Swiveling angle: ± 120 degrees Flexible Bag Arm: Length: 550mm The height and angle of the flexible bag arm can be adjusted freely.
Drawers (internal dimensions):	Weight limit: 5 kg Drawers are of equal size: <ul style="list-style-type: none"> • Height: 140 mm • Width: 420 mm • Depth: 315 mm
Caster:	4 casters Diameter: 125 mm Brake: central brake with lock/unlock indicator Cable pusher: cable pusher with each caster
System Noise (under the typical working mode):	$\leq 50\text{dB(A)}$

TABLE 12-2 Physical Specifications

12.8.8 Breathing Circuit Parameters

System Compliance:	≤ 2 ml/cm H ₂ O
Resistance:	≤ 0.6 kPa
Leakage:	≤ 50 ml/min @ 3.0 kPa (under BTPS condition)
System Safety Pressure on Breathing System:	110 cmH ₂ O

TABLE 12-22 Breathing Circuit Parameters

12.9 31. Anesthetic Gas Scavenging System (AGSS)

Type of the Applicable Disposable System:	Low flow
Extract Flow:	25 to 50 L/min
Resistance:	≤ 0.05 kPa @ 25 L/min ≤ 0.05 kPa @ 30 L/min ≤ 0.35 kPa @ 50 L/min ≤ 0.35 kPa @ 75 L/min

TABLE 12-23 Anesthetic Gas Scavenging System with Low Flow (AGSS)

Type of the Applicable Disposable System:	High flow
Extract Flow:	75 to 105L/min
Resistance:	≤ 0.05 kPa @ 30 L/min ≤ 0.35 kPa @ 75L/min ≤ 0.35 kPa @ 105 L/min

TABLE 12-24 Anesthetic Gas Scavenging System with High Flow (AGSS)

12.10 Negative Pressure Suction device

12.10.1 Continuous Suction Regulator

18. Performance Category:	Pharyngeal Suction
2.2.. Gas Supply:	External vacuum system
Gas Supply Pressure Range:	-72 kPa to -40 kPa
Flow Input Range:	20 L/min to 40 L/min
Maximum Vacuum:	69 kPa to 72 kPa (517.5 mmHg to 540 mmHg) with external vacuum applied of 72 kPa (540 mmHg) and 40 L/min free flow
Maximum Flow:	39 L/min to 40 L/min with external vacuum applied of 72 kPa (540 mmHg) and 40 L/min free flow
Minimum Flow:	20 L/min
Vacuum Gauge Accuracy:	± 5 % of full scale

TABLE 12-25 Continuous Suction Regulator

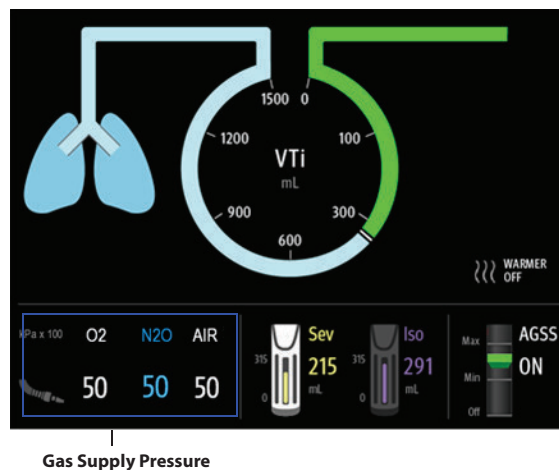



Figure 4-49 Gas supply pressure monitoring

To change the gas supply pressure unit, perform the following settings:

1. Select the  soft key > [System] soft key (system password required) > [Setup] > [Language/Unit] tab.
2. Set [Gas Supply Pressure] to [kPa], [psi] or [bar].

4.10.3 Vaporizer

When the system detects a vaporizer, it displays the status and agent volume of the vaporizer.

- When the vaporizer is in use the vaporizer image on the status screen is highlighted.
- When the vaporizer is turned off, the vaporizer image on the status screen turns gray.
- 9.1. • When the vaporizer triggers a [Vaporizer Liquid Level Low] or [Vaporizer Almost Empty] alarm, the agent volume on the screen flashes and is highlighted in the color matching the alarm priority.
- When the vaporizer triggers other alarms, the border of the vaporizer turns to the color matching the alarm priority.

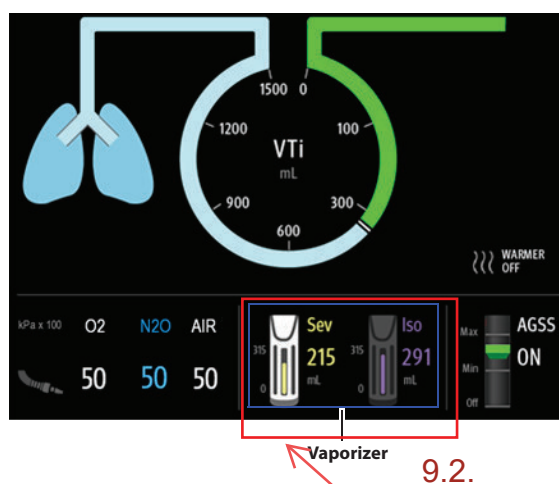


Figure 4-50 Vaporizer

8. Abi jungtys aktyvios

10.8.2.9 AGSS alarms

INFORMATION	CAUSE	ACTION	ALARM PRIORITY	MACHINE MODE WHEN CHECKED	DISABLED IN STANDBY MODE
Scavenging Flow is Too High	The AGSS flow rate is higher than the upper limit.	Set the vacuum flow so that the float position is between the Min and Max lines.	Low	Runtime	No
AGSS Failure	AGSS failure.	Please contact Mindray Technical Support.	Medium	Runtime	No

Table 10-12 AGSS alarms

10.8.2.10 Vaporizer alarms

NOTE: AA stands for any of the following anesthetic agents: Des (Desflurane), Iso (Isoflurane), and Sev (Sevoflurane).

9.1.

INFORMATION	CAUSE	ACTION	ALARM PRIORITY	MACHINE MODE WHEN CHECKED	DISABLED IN STANDBY MODE
AA Vaporizer Liquid Level Low	Liquid level lower than 50 ml.	Please fill in the drug.	Low	Runtime	No
AA Vaporizer Almost Empty	Liquid level lower than the min level.	Please fill in the drug.	High	Runtime	No
AA Vaporizer Lid is Open	Vaporizer lid is open.	Close the vaporizer lid.	Low or medium	Runtime	No
AA Vaporizer Failure	Vaporizer failure.	Replace the vaporizer or contact Mindray Technical Support.	High	Runtime	No
AA Vaporizer Selftest Error	Vaporizer self-test error.	1. Re-install or replace the vaporizer. 2. Please contact Mindray Technical Support if the problem persists.	High	Runtime	No
AA Vaporizer Comm Stop	The vaporizer lost communication with the CPU board for 10 seconds.	1. Re-install or replace the vaporizer. 2. Please contact Mindray Technical Support if the problem persists.	High	Runtime	No

Table 10-13 Vaporizer alarms

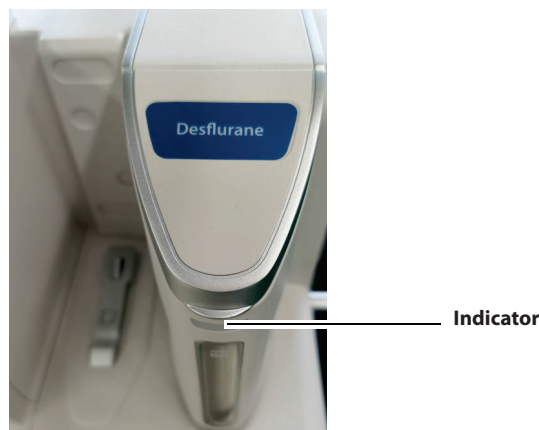


Figure 3-3 Vaporizer Indicator

3. To disassemble the vaporizer, keep the vaporizer in the inactive mode by setting the concentration to 0. Press the button on the handle, then pull the vaporizer out along the vaporizer rail.

3.4.1 Filling the Anesthetic Agent

The vaporizer can be filled either when installed on the anesthesia system or when not connected to the main unit. Filling methods for both approaches are the same.

The anesthetic agent liquid level can be observed in the glass-tube liquid-level meter of the vaporizer, or monitored on the display of the main unit. If the liquid level of the vaporizer is low, the main unit will prompt message alerts; if the liquid level of the vaporizer is close to being empty, the main unit will prompt alarms.

Use the correct filling adapter to fill the vaporizer. See the following for details:

ANESTHETIC AGENT	FILLING ADAPTER
Isoflurane	Mindray safety filling adapter
Sevoflurane	Quik-Fil, Mindray safety filling adapter
Desflurane	Saf-T-fil

WARNING: The filling adapter should be matched with the anesthetic agent bottle and vaporizer type.

CAUTION: The vaporizer can be refilled during use however the vaporizer will stop delivering anesthetic agent when the vaporizer cover is open.

The anesthetic agent is filled to the Isoflurane and Sevoflurane vaporizers per the following steps:

1. Open the anesthetic agent bottle, and install the filling adapter matching the anesthetic agent.
2. Open the vaporizer cover, insert the anesthetic agent bottle to the vaporizer filling hole and press the bottle downward. Press hard on the anesthetic agent bottle to activate the self-sealing system of the vaporizer so that fluid in the bottle flows into the vaporizer.
3. After filling is complete, pull out the anesthetic agent bottle.
4. Close the vaporizer cover.

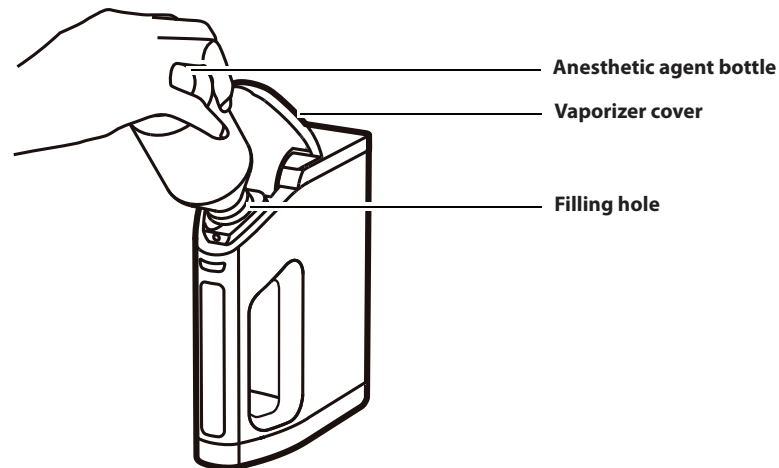


Figure 3-4 Fill the anesthetic agent (Isoflurane and Sevoflurane)

The anesthetic agent is filled to the Desflurane vaporizer per the following steps:

1. Open the Desflurane bottle.
2. Open the vaporizer cover and insert the anesthetic agent bottle to the vaporizer filling hole. You will hear a snap when the bottle is locked in place to the vaporizer, and the bottle cannot be pulled out. Press hard on the anesthetic agent bottle to activate the self-sealing system of the vaporizer so that fluid in the bottle flows into the vaporizer.
3. After filling is complete, stop pressing the anesthetic agent bottle. Hold the bottle with one hand and press the unlocking cover plate with the other hand to unlock the bottle from the vaporizer. Then pull out the bottle.
4. Close the vaporizer cover.

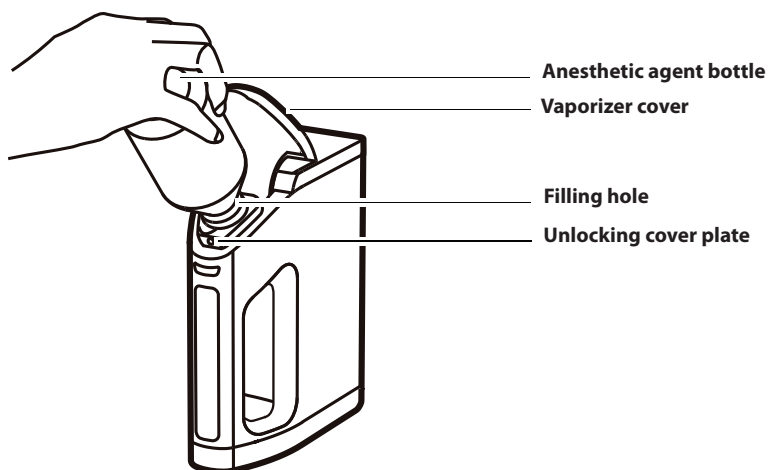


Figure 3-5 Fill the anesthetic agent (Desflurane)

10.

- Set the balance gas flow.
- Set the O₂ flow.
- Set the anesthetic agent concentration of the vaporizer.

4.3.1.3

Automatic controlled anesthesia

Automatic controlled anesthesia is an automatic fresh gas control mode with the monitored O₂ and AA concentration on the patient end as the targets. In the automatic controlled anesthesia mode, users need to set the target FiO₂, the target EtAA or the target MAC on the patient end. The system monitors the inhaled and exhaled gas concentration on the patient end in real time, and adjusts the fresh gas and the vaporizer based on the feedback of the gap between the monitored value and the user-defined target value to enable the O₂ and AA concentration on the patient end to quickly reach and remain at the set targets. After the user-defined targets are reached, the system will automatically reduce the fresh gas flow and implement low-flow anesthesia. Users can set the minimum fresh gas flow to limit the minimum fresh gas flow for low-flow anesthesia.

The automatic controlled anesthesia mode is shown in the following figure:



Figure 4-14 Automatic Controlled Anesthesia Mode

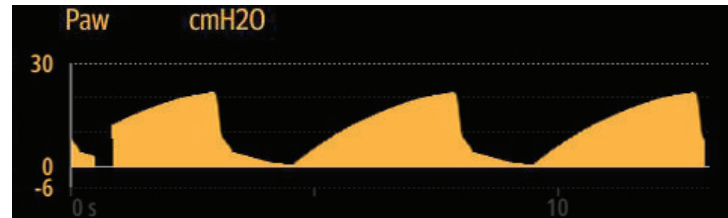
Select the automatic controlled anesthesia zone and open the following menu.

Electronic Flowmeter:	Direct Flow Control Mode: O ₂ flow range: 0.00 L/min, 0.20 to 15.0 L/min Air flow range: 0.00 to 15.0 L/min N ₂ O flow range: 0.00 to 12.0 L/min O ₂ flow accuracy: ± 50 mL/min or ± 5 % of setting value, whichever is greater Balance gas (Air/N ₂ O) flow accuracy: ± 50 mL/min or ± 5 % of setting value, whichever is greater O ₂ concentration range in the O ₂ /N ₂ O mixed gas: ≥ 25 % Total Flow Control Mode: Total flow range: 0.00 L/min, 0.20 to 20.0 L/min Total flow accuracy: ± 100 mL/min or ± 5 % of setting value, whichever is greater O ₂ concentration range: 21 % to 100 % (The balance gas is Air) 26 % to 100 % (The balance gas is N ₂ O) O ₂ concentration accuracy: Volume fraction of ±5% (Flow <1L/min) ± 5 % of the setting value (Flow ≥1L/min)
Backup Flowmeter, Control Needle Valve and Knob:	Flow display on screen: O ₂ flow range: (1.0±0.5) L/min to 15 L/min Air flow range: 0 to 15 L/min Flowmeter display accuracy: ± 10 % of the indicated value (under the condition of 20°C and 101.3kPa, for flow between 10% and 100% of full scale) Glass tube flow display: Glass tube flowmeter display range: 0 to 15 L/min Flowmeter display accuracy: ± 10 % of the indicated value (under the condition of 20°C and 101.3kPa, for flow between 10% and 100% of full scale)
Auxiliary Flowmeter:	Total flow adjustable range: 0.0 L/min to 15.0 L/min Total flow control accuracy: ± 100 mL/min or ± 10 % of the setting value, whichever is greater O ₂ concentration adjustable range: 21% to 100% O ₂ concentration control accuracy: Volume fraction of ± 5 % Glass tube flowmeter display range: 0 L/min to 15 L/min Glass tube flowmeter display accuracy: ± 10 % of the indicated value (under the condition of 20°C and 101.3kPa, for flow between 10% and 100% of full scale)
High Flow Nasal Cannula Oxygen (HFNC)	O ₂ concentration setting range: 21 % to 100 % O ₂ concentration control accuracy: Volume fraction of ± 5 % Flow control range: 2 L/min to 100 L/min Flow control accuracy: ± (2 L/min + 10 % of the setting value)
High Pressure Oxygen Outlet:	Pressure range: 280 to 600 kPa Maximum flow: ≥ 90 L/min
O₂ Flush:	Flow range: 35 to 50 L/min
Airway Pressure Gauge:	Range: -20 to 100 cmH ₂ O Accuracy: ± (2 % of full scale reading + 4 % of actual reading)

TABLE 12-47 Pneumatic Controls

Plimit Line

Set the **[Plimit Line]** to ☐ (off) or ☒ (on). The Plimit line function displays a dashed line in the Pressure waveform area to indicate the Plimit position. The Plimit line can be displayed in VCV, SIMV-VC, SIMV-VG and PCV-VG modes.



NOTE: The Plimit line does not affect the auto-scaling algorithm. If the Plimit line is turned on but not visible, it may be because the line is positioned off the waveform scale.

16. Breathing System Warmer

The **[Breathing System Warmer]** can be set to ☐ (off) or ☒ (on). If the **[Breathing System Warmer]** is ☐ (off), or if AC power is not connected, the system displays an icon to indicate that the warmer is not active.



After cycling power, the Breathing System Warmer will return to the default state.

NOTE: The Breathing System Warmer is inactive when the equipment is powered by battery.

2.2.5 Main Unit (Top View)

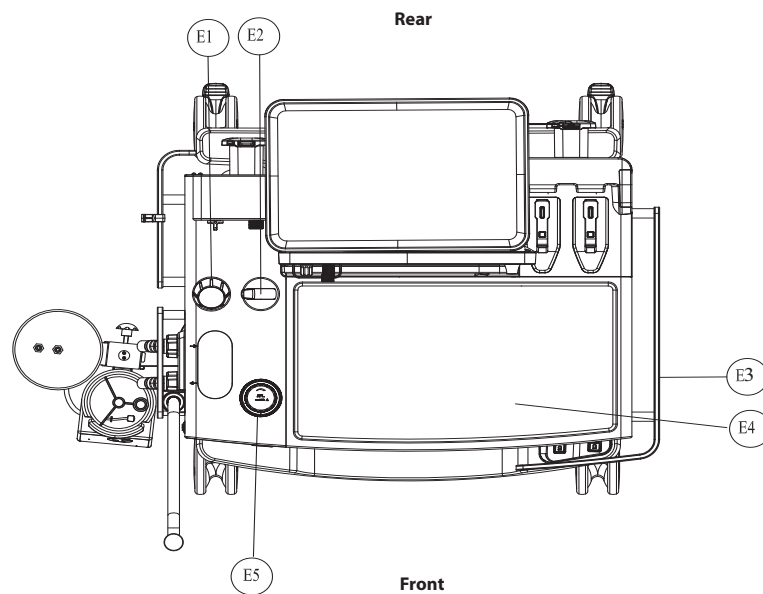


Figure 2-6 Main Unit (Top View)

PARTS		DESCRIPTION
E1	Airway pressure gauge¹	Used to indicate the airway pressure of patients.
		NOTE: It is normal to have a minor difference between the airway pressure gauge reading and the electronically monitored value. When the difference is greater than 15%, please contact your service personnel or Mindray.
E2	Manual/Auto switch	Used to switch between the automatic ventilation and manual ventilation modes.
E3	Handle	The handle is intended to be used for pushing/pulling/rotating the anesthesia system, with a maximum force capacity 80 kgf.
E4	Workbench	Workbench surface (stainless steel), with a maximum force capacity of 30 kgf.

17.

PARTS	DESCRIPTION
E5 APL valve¹	Used to set the rotary pressure regulating valve of the breathing system during manual ventilation. Its scales represent the approximate pressure values. Set the APL valve to the SP position during spontaneous respiration. Elevate the APL valve upward as needed to release the pressure quickly. At a flow of 3L/min, the pressure of the APL valve should be between 1cmH ₂ O and 3cmH ₂ O (exclusive) either in dry or humid conditions. At a flow of 30L/min, the pressure of the APL valve should be between 1cmH ₂ O and 5cmH ₂ O (exclusive) either in dry or humid conditions.

¹ The APL valve and PAW gauge numerics are for reference only. Calibrated patient airway pressure is displayed on the user screen.

2.2.6 Breathing System

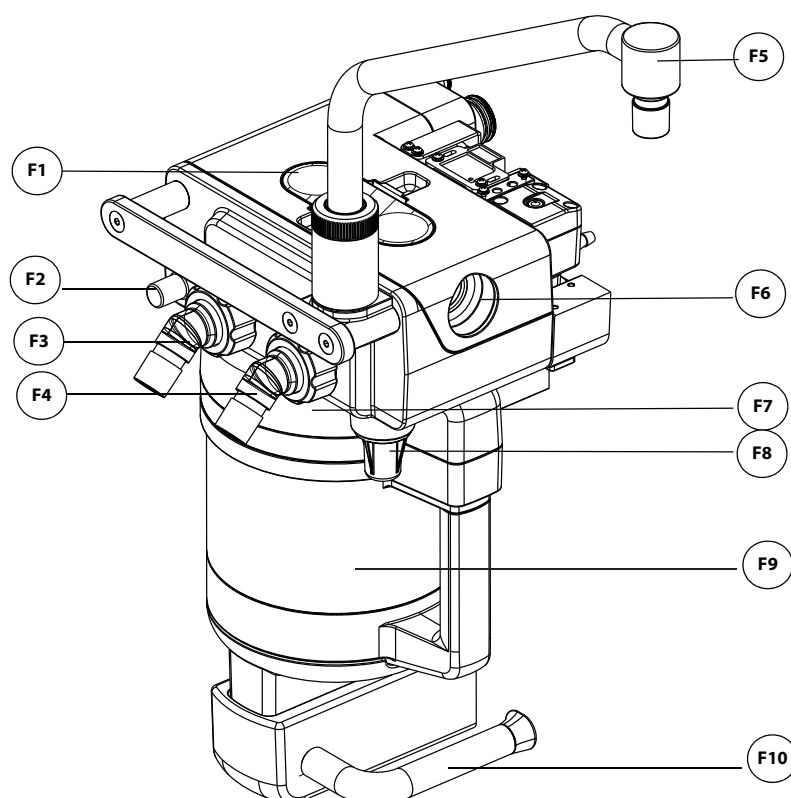





Figure 2-7 Breathing System

PARTS	DESCRIPTION
F1 Observation window of expiratory/inspiratory check valve	Used to observe the status of expiratory and inspiratory check valves from outside the equipment.
F2 Leak test plug	Used to connect to a breathing tube for leak tests.

Clicking the vaporizer concentration settings keys in the Fresh Gas Control area to open the dialog box, you can set the [Purge Flow Rate] and [Purge] to  (off) or  (on). When the [Purge] to  (on), the breathing system starts the anesthetic gas purge.

6.6 Set Ventilation

NOTE: In all ventilation modes, when inspiration pressure reaches the upper limit of PAW alarms, the system switches to expiration immediately and airway pressure is released.

NOTE: In case of a fault with the drive gas supply, the Auto ventilation mode won't function normally.

6.6.1 Change Ventilation Mode

To change ventilation mode to Manual:

Use the Auto/Manual switch on the breathing system to enter and exit Manual ventilation mode.

To change ventilation mode to VCV, SIMV-VC, PCV, PCV-VG, SIMV-PC, SIMV-VG, CPAP/PS, APRV or AMV:

1. Select the tab of the desired ventilation mode. The [Set Mode] button (or [Preset Mode] button in manual mode) will flash (Figure 6-2).
2. Select the [Set Mode] button (or [Preset Mode] button in manual mode) to confirm the change. If the [Set Mode] button is not selected after several seconds, an audio reminder will sound for several seconds and then the system will return to the previous ventilation mode.
3. Optionally, select each available ventilation parameter to edit the parameter setting.
4. Move the Auto/Manual Switch to the Auto position.



Figure 6-2 Ventilation Mode Tabs

6.6.2 Set Manual Ventilation Mode

Manual ventilation mode is the operating mode used to manually ventilate the patients or allow patients to breathe spontaneously. To use the manual mode, the user must first set the APL valve to the desired pressure value and then use the Auto/Manual switch on the breathing module to enter and exit Manual mode. Push the [O₂ Flush] button to inflate the bag if necessary.

Set the APL Valve for Manual Ventilation

Rotate the APL valve adjustment knob to the desired pressure. The number on the knob that lines up with the index mark on the bottom section of the valve indicates the approximate pressure setting.

NOTE: Clockwise rotation increases the pressure, and counter clockwise rotation decreases the pressure.

The patient can be ventilated manually using the breathing bag. The pressure will be limited to the value set on the APL valve.

20.

12.8 Breathing System Specifications

12.8.1 Breathing System Volume

Mechanical Ventilation:	1800mL
Manual Ventilation:	1950mL

TABLE 12-15 Breathing System Volume

$$1800 + 1500 = 3300 \text{ ml.} = 3,3 \text{ l.}$$

12.8.2 Volume Exchanger Volume

Volume:	1500mL
----------------	--------

TABLE 12-16 Volume Exchanger Volume

12.8.3 CO₂ Absorber Assembly

Absorber Capacity:	1 Pre-Pak (1500ml)
Absorber Canister Contents:	1 Pre-Pak canister or Loose Fill absorbent

TABLE 12-17 CO₂ Absorber Assembly

12.8.4 Breathing System Connections

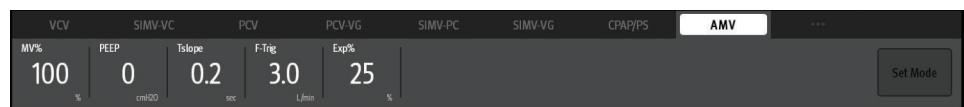
Exhalation Connection:	Coaxial 22mm male/15mm female conical connector
Inhalation Connection:	Coaxial 22mm male/15mm female conical connector
Manual bag connection:	Coaxial 22mm male/15mm female conical connector
Exhaust port:	30mm male conical connector

TABLE 12-18 Breathing System Connections

[30, 40)	15	1	14
[40, 60)	15	1	12
[60, 90)	15	1	10
[90, 100)	18	1.5	10
≥ 100	20	1.5	10

Table 6-1 Trial ventilation cycle parameters

After three trial ventilations, the ventilation enters automatic adjustment stage. With minimizing the work of breath as the principle, the actual minute ventilation is ensured to stay close to the minute ventilation setting. If the patient has no spontaneous respiration, enable automatic ventilation. If the patient restores spontaneous respiration, enable support ventilation.

**Figure 6-12** Adaptive minute ventilation tab**Set AMV Mode:**

1. Select the AMV tab on the Main Screen.
2. Select the parameter soft key and assign an appropriate value on the pop-up screen.
3. Check that all AMV parameters are set appropriately.
4. Select the [Set Mode] soft key to confirm the settings.

AMV parameters:

- MV%: percentage of minute ventilation
- PEEP: positive end-expiratory pressure
- Tslope: rise time
- F-Trig/P-Trig: flow trigger level/pressure trigger level
- Exp%: expiration trigger level

NOTE: Before activating a new automatic ventilation mode, ensure that all related parameters are set appropriately.

6.6.11 Lung Recruitment Ventilation

Lung recruitment is a lung-protective ventilation strategy. The ventilator intermittently supplies gases of a pressure higher than the mean airway pressure, and sustains the pressure for a period of time during the automatic ventilation. In this way, the lung recruitment maneuvers open more collapsed pulmonary alveoli and prevent the secondary pulmonary atelectasis caused by the low tidal volumes ventilation.

For the safety of the ventilation and observing the effect of the lung recruitment ventilation, the anesthesia system needs to perform real-time monitoring over PEAK, PEEP, C, and Vte during the lung recruitment ventilation.

NOTE: Recruitment can only be used in automatic ventilation modes.

NOTE: Generally, 100% O₂ or high-concentration O₂ is used for ventilation during lung recruitment.

NOTE: It is not recommended to use lung recruitment where patients may spontaneously breath.

NOTE: Terminate the lung recruitment ventilation when the physiological state of the patient is abnormal.

6.6.11.1 One-Step Recruitment 21.1.

NOTE: Before activating the lung recruitment ventilation, ensure that all related parameters are set appropriately.

1. On the Main Screen, select the [Procedures] soft key > [One-Step Recruitment].
2. Set the lung recruitment parameters in the pop-up menu.
3. Select the [Start] soft key to start the lung recruitment ventilation. [Recruitment] is displayed in the current ventilation mode area.

21.1.

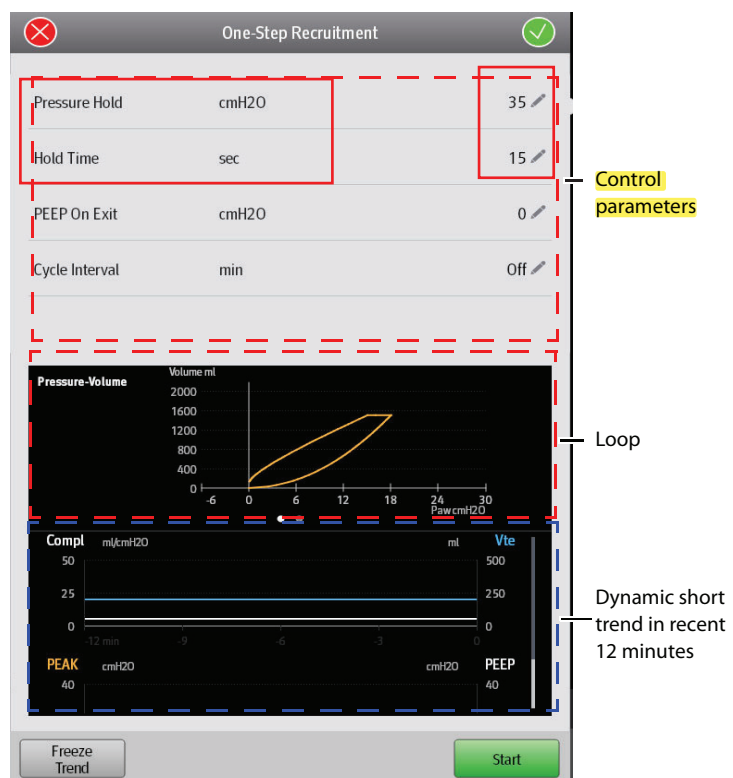


Figure 6-13 One-Step Recruitment

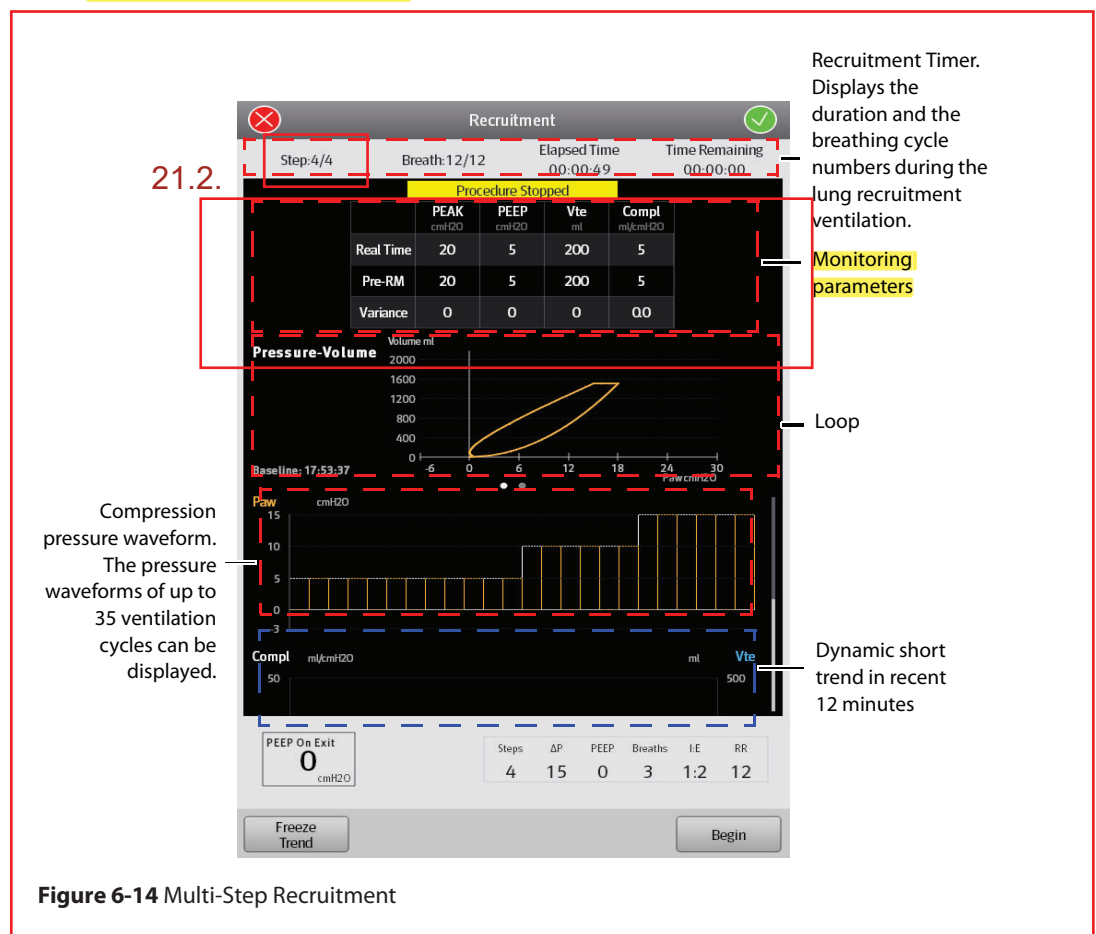
Recruitment parameters:

- Pressure Hold: the lung recruitment ventilation pressure.
- Duration: the lung recruitment ventilation duration.
- PEEP On Exit or Plow On Exit: the positive end-expiratory pressure or low pressure level upon exit from the lung recruitment ventilation mode.

21.3. • Cycle Interval: reminds users of the interval of starting lung recruitment ventilation.

6.6.11.2 Multi-Step Recruitment 21.2.

1. On the Main Screen, select the [Procedures] soft key > [Multi-Step Recruitment].
2. Select [Procedures] in the pop-up menu. If necessary, you can edit the current procedure.
3. Select the [Start] soft key to start the lung recruitment ventilation. [Recruitment] is displayed in the current ventilation mode area.



21.2. Recruitment parameters:

- Step: Step of the lung recruitment ventilation. It sets the step number or sets it to off.
- ΔP: Support pressure in a certain step of lung recruitment ventilation.
- PEEP: Positive end-expiratory pressure in a certain step of lung recruitment ventilation.
- Breaths: Breath cycle numbers in a certain step of the lung recruitment ventilation.
- I:E: Ratio of inspiratory time to expiratory time in a certain step of lung recruitment ventilation.
- RR: Respiratory rate in a certain step of lung recruitment ventilation.
- **PEEP On Exit** or **Plow On Exit**: the positive end-expiratory pressure or low pressure level upon exit from the lung recruitment ventilation mode.

6.6.11.3 Parameter Monitoring

During the lung recruitment ventilation, the anesthesia system monitors PEAK, PEEP, Vte and Compl in real time.

6.6.11.4 Freeze Trend

Freeze the trend waveforms by selecting the **[Freeze Trend]** soft key in the Recruitment menu.

When trends are in the frozen status, select the **[Unfreeze Trend]** soft key to exit the frozen status.

6.7 Other Features

6.7.1 Auxiliary Common Gas Outlet (ACGO) Mode

If the equipment is configured with an ACGO switch, the system enters or exits ACGO mode by turning on or off the ACGO switch.



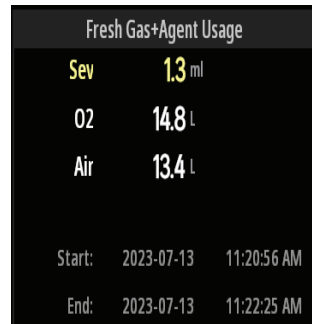
Figure 6-15 ACGO mode

25.

7.3 Agent Usage Calculation

CAUTION: The Agent Usage Calculation feature is intended for management purposes only and shall not be used as a basis for clinical decision-making.






The agent usage is displayed on the standby screen. The agent usage accumulates from 0 when the anesthesia system exits the standby mode. When the anesthesia system enters standby, the agent usage stops accumulating.



25.

Figure 7-1 Agent Usage Calculation

Enable or disable the Agent Usage Calculation feature following the steps below:

1. Select the  soft key > [System] soft key (system password required) > [Setup] > [Optimizer] soft key.
2. Set the [Agent Usage] to  (off) or  (on). If the [Agent Usage] is set to  (off), no agent usage data is displayed on the Main Screen. If the [Agent Usage] is set to  (on), the agent usage is displayed on the Main Screen.

7.4 Agent Consumption Speed

CAUTION: The Agent Consumption Speed feature is intended for management purposes only and shall not be used as a basis for clinical decision-making.

The anesthesia system supports calculation of the agent consumption speed and cost.

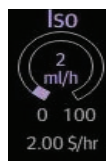


Figure 7-2 Agent Consumption Speed

After the system exits from the **[Flow Pause]** state:

- The fresh gas flow resumes at the settings from before entering the **[Flow Pause]** state.
- Ventilation resumes in the same ventilation mode and with the same parameter settings as before entering the **[Flow Pause]** state.
- Physiological alarms related to ventilation and gas are enabled.

4.8.4 Cardiac Bypass Mode

See (Pages 6-21) 6.7.3 "Cardiac Bypass Mode".

4.8.5 Screens

Select the **[Capture Event/Screens]** soft key, and the system will save the current screen as an image in the **[png]** format and log the current monitoring and event to the Event Log (See Pages 4-30 "Event Log"). The anesthesia system can store up to 50 images.

4.8.6 Alarms

26. Select the **[Alarms]** soft key on the Main Screen to open the **[Alarms]** menu where you can set the alarm limits and view active alarms (See (Pages 10-1) 10.0 "Alarms and Messages").

4.8.7 Alarm Reset

See (Pages 10-7) 10.6 "Setting Alarm Limits".

4.8.8 Audio Pause

See (Pages 10-6) 10.4 "Pause Alarm Audio".

4.9 Setup Menu

Select the  icon to open the **[Setup]** menu (Figure 4-35).

NOTE: The **[System]** soft key is only available in the standby mode.

NOTE: The **[Service]** tab is for use only by Mindray Technical Service. Please contact Mindray Technical Support for details.

10.6 Setting Alarm Limits

26.

Users can set the limits of PEAK, MV, Vte, RR, FiO₂, EtO₂, EtCO₂ and FiCO₂ alarms to align the alarm conditions consistent with patient needs. The alarm is then triggered when the parameter value is greater than the High Limit or lower than the Low Limit.

WARNING: During equipment use, pay frequent attention to the alarm limits of parameters to ensure that they are appropriately set. Setting the alarm limits to limiting values will render the alarming system unhelpful.

NOTE: When using the anesthesia system, ensure that the alarm limits of each parameter are set to the appropriate values for the patient.

NOTE: When the anesthesia system restarts within 60 seconds after a power outage, the system can automatically restore the recent profile. If the power outage lasts longer than 120 seconds, the anesthesia system will automatically load the user profile before the shutdown. If the power outage lasts between 60 to 120 seconds, the anesthesia system may automatically restore the recent profile or automatically load the user profile before the shutdown.

NOTE: If the equipment is powered off for less than 30 seconds and then powered on, the alarming settings will be restored to the status before the system was powered off.

NOTE: If the airway pressure monitoring stays lower than the lower limit of alarm for 20 seconds or one automatic ventilation cycle (depending on which one is longer), a corresponding alarm will be triggered.

NOTE: If the Vte monitoring stays higher than the upper limit of alarm for three consecutive cycles, a corresponding alarm will be triggered.

NOTE: If the Vte monitoring stays lower than the lower limit of alarm for three consecutive cycles, a corresponding alarm will be triggered.

NOTE: In the manual ventilation mode, the system will disable the [Paw Too Low] alarm, and the PEAK low alarm limit in monitoring parameters area will display [Off].

10.6.1 Auto Alarm Limits

The Auto Alarm Limits function uses an algorithm based on measured values. The relationship is shown in the table below.

26. When the System is in Standby mode or Manual mode, the **[Auto Alarm Limits]** button will be disabled. The **[Auto Alarm Limits]** key is also disabled when the current mode is PS, SIMV-VC, or SIMV-PC.

ALARM LIMIT	ADJUSTMENT FORMULA
PEAK High	PEAK+5 or PLAT+10, whichever is greater. Minimum: 35 cmH ₂ O.
PEAK Low	(PLAT-PEEP) x 0.6 + PEEP - 1 Minimum: 3 cmH ₂ O. Maximum (PEAK High - 1)
MV High	MV x 1.4 Minimum: 2.0 L/min
MV Low	MV x 0.6 Minimum: 0.1 L/min Maximum (MV High - 0.1)
Vte High	Vte x 1.4
Vte Low	Vte x 0.6
RR High	RR x 1.4
RR Low	RR x 0.6

Table 10-2 Auto Alarm Limits

The parameters in the formula are all measured parameters.

The alarm limits for PEAK are calculated on the basis of the average value for PEAK, PLAT, and PEEP. The value used for average uses the value of the last four ventilation cycles or the value in one minute, whichever is smaller. Spontaneous breaths by the patient are not taken into account.

The alarm limits for Vt and RR are calculated on the basis of the average value. The value used for average uses the value of the last four ventilation cycles or the value in one minute, whichever is smaller. Spontaneous breaths by the patient are not taken into account.

If there is no valid MV, Vte or RR measurement value, the corresponding alarm limits will not be adjusted.

If the average value of PEAK, PLAT, and PEEP cannot be calculated, the corresponding alarm limits will not adjust.

If the calculated alarm limit is more than the high threshold of setting range or less than the low threshold, the corresponding threshold is used as the auto alarm limit.

4.1 Main Screen

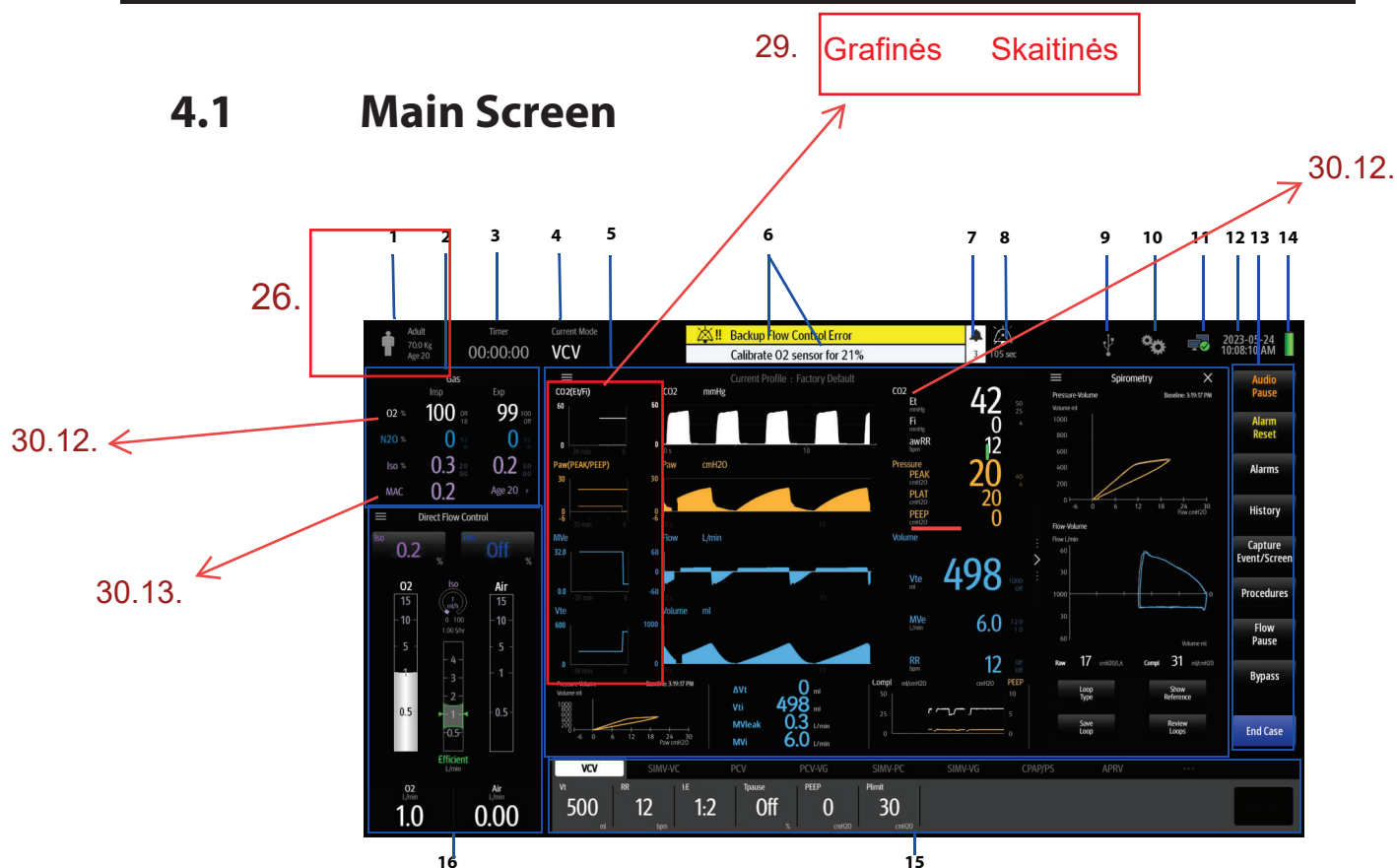


Figure 4-1 Main Screen

SERIAL NO.	MAIN SCREEN	DESCRIPTION
1	Patient information	Shows the information of the current patient, including the patient type, weight and age. You can click on the section to view more personal information of the patient. See (Pages 4-3) 4.2.1 "Patient Information".
2	Gas Area	The section displays parameter information in real time when the Gas or O ₂ Sensor module is configured.
3	Elapsed / Countdown Timer	Displays elapsed time. Select to start, stop, or reset the timer.
4	Current ventilation mode	Displays the current ventilation mode.
5	Waveform/parameter/spirometry/trend/Paw gauge/prediction/Anaesthesia display zone	Displays the waveforms, monitoring parameters, spirometry, trends, Paw gauge, anesthesia predictions and Anaesthesia.

Table 4-1 Main Screen

SERIAL NO.	MAIN SCREEN	DESCRIPTION
6	Alarm/prompt message zone	<p>Displays physiological alarms, technical alarms and prompt messages. The most recent and top-priority alarm is displayed in the topmost section.</p> <p>Other alarms are displayed in the lower section, grouped by priority for scrolled display. Select the zone to display a list of all active alarms.</p> <p>See the table in Section "Alarms and Prompt Messages" on Pages 10-11 for a list of prompt messages and related priorities. Alarms with a high priority are displayed in red. Alarms with a medium priority are displayed in yellow. Alarms with a low priority are displayed in cyan. Prompt messages are displayed in white.</p>
7	Number of active alarms	Displays the current numbers of active alarms and prompts.
8	Audio Pause/Alarm Reset icon	When the [Audio Pause] or [Alarm Reset] soft key is selected, the Audio Pause or Alarm Reset icon is displayed along with a 120-second countdown timer.
9	U disk icon	The U disk icon is displayed when the anesthesia system recognizes that U disk is connected to the anesthesia system.
10	Setup icon	Select the icon to open the [Setup] menu.
11	Network connection icon	Displays the network connection status.
12	System date and time	Displays the current system date and time. To adjust the date and time, see "Date and Time" on Pages 4-7.
13	Soft key field	Displays the [Audio Pause] soft key, the [Alarm Reset] soft key, the [Alarms] soft key, the [History] soft key, the [Capture Event/Screens] soft key, the [Procedures] soft key, the [Flow Pause] soft key, the [Bypass] soft key, the [Standby] soft key or the [Start Case] soft key. See (Pages 4-27) 4.8 "System Soft Key".
14	Main power supply and battery status icon	Displays the main power supply and battery status, See Pages 4-7 "Battery Status" .
15	Ventilation mode and setting parameter zone	Displays tabs for all ventilation modes. Each tab displays the ventilation mode and its parameters. Select a tab and the [Set Mode] soft key to change the ventilation mode. Select the parameter key to change the parameter settings. See "Set Ventilation" on Pages 6-6.
16	Display zone of fresh gas control/vaporizer/anesthetic agent consumption speed	<p>Displays the real-time flow and optimizer information of O₂ or balance gas. Select the zone to set the fresh gas flow and automatic controlled anesthesia in the pop-up menu.</p> <p>Displays the gas concentration of the vaporizer.</p> <p>Displays the anesthetic agent consumption speed and cost.</p>

Table 4-1 Main Screen

4.2 System Information Title

4.2.1 Patient Information

An icon displaying the information of the current patient. Select the icon to open the **Patient Information** menu. You can set the data for patients and hospitals in the Patient Information menu.

SERIAL NO.	MAIN SCREEN	DESCRIPTION
6	Alarm/prompt message zone	<p>Displays physiological alarms, technical alarms and prompt messages. The most recent and top-priority alarm is displayed in the topmost section.</p> <p>Other alarms are displayed in the lower section, grouped by priority for scrolled display. Select the zone to display a list of all active alarms.</p> <p>See the table in Section "Alarms and Prompt Messages" on Pages 10-11 for a list of prompt messages and related priorities. Alarms with a high priority are displayed in red. Alarms with a medium priority are displayed in yellow. Alarms with a low priority are displayed in cyan. Prompt messages are displayed in white.</p>
7	Number of active alarms	Displays the current numbers of active alarms and prompts.
8	Audio Pause/Alarm Reset icon	When the [Audio Pause] or [Alarm Reset] soft key is selected, the Audio Pause or Alarm Reset icon is displayed along with a 120-second countdown timer.
9	U disk icon	The U disk icon is displayed when the anesthesia system recognizes that U disk is connected to the anesthesia system.
10	Setup icon	Select the icon to open the [Setup] menu.
11	Network connection icon	Displays the network connection status.
12	System date and time	Displays the current system date and time. To adjust the date and time, see "Date and Time" on Pages 4-7.
13	Soft key field	Displays the [Audio Pause] soft key, the [Alarm Reset] soft key, the [Alarms] soft key, the [History] soft key, the [Capture Event/Screens] soft key, the [Procedures] soft key, the [Flow Pause] soft key, the [Bypass] soft key, the [Standby] soft key or the [Start Case] soft key. See (Pages 4-27) 4.8 "System Soft Key".
14	Main power supply and battery status icon	Displays the main power supply and battery status, See Pages 4-7 "Battery Status" .
15	Ventilation mode and setting parameter zone	Displays tabs for all ventilation modes. Each tab displays the ventilation mode and its parameters. Select a tab and the [Set Mode] soft key to change the ventilation mode. Select the parameter key to change the parameter settings. See "Set Ventilation" on Pages 6-6.
16	Display zone of fresh gas control/vaporizer/anesthetic agent consumption speed	<p>Displays the real-time flow and optimizer information of O₂ or balance gas. Select the zone to set the fresh gas flow and automatic controlled anesthesia in the pop-up menu.</p> <p>Displays the gas concentration of the vaporizer.</p> <p>Displays the anesthetic agent consumption speed and cost.</p>

Table 4-1 Main Screen

4.2 System Information Title

4.2.1 Patient Information

27. An icon displaying the information of the current patient. Select the icon to open the **Patient Information** menu. You can set the data for patients and hospitals in the Patient Information menu.



Figure 4-2 Patient information icon

Figure 4-3 Patient Information menu

NOTE: The equipment saves the latest patient parameter settings for each patient type: Adult, Pediatric, and Neonate. Changing to another patient size does not clear the parameter settings for the previous patient size. For example, changing from Adult to Pediatric and back to Adult will result in the Adult patient parameter settings still being saved.

EDITABLE FIELD	DESCRIPTION
Patient ID	
Visit Number	Enter up to 30 digits for each field. The fields will be cleared when the equipment powers off or enters the standby mode.
First Name	
Last Name	
Size	
Gender	Radio option.
Height	
Age	Enter information using the virtual keyboard. The system will display prompt messages if the entered information exceeds the allowed range.
Weight	
IBW	

Table 4-2 Patient information

5.4 System Check

27. 1. **From system being turned on:**
When the system is turned on, it automatically initiates the Power On Self Test (POST). After the POST is over, the system check screen is displayed.





Alternatively, on the *Main Screen*:

Enter the standby screen, select the  soft key > **[System Check]** soft key, and enter the system check screen.

2. Follow the instructions on the Main Screen for operations.
3. Select the **[Continue]** soft key and the system starts the check.
4. Select **[Test Details]** to view the test results of each test item.
5. You can then proceed to standby or troubleshoot the equipment based on the test results.
6. After the system check is over, the Preoperative Checklist screen is displayed. Perform desired preoperative checks as per the prompts on the screen.


	SYSTEM CHECK ITEMS	DESCRIPTION	REMARK
27.	1. Startup	When the system is turned on, it performs a check to ensure its alarm system (alarm LED and speaker) and hardware (flowmeter board, ventilator board, auxiliary ventilator board, power board, and CPU board) are functioning properly.	Confirm that the buzzer plays the check sound when the power on self test is started.
	2. System Check	Performs leak and compliance tests, vaporizer tests and AGSS tests. Checks the hardware, valves, sensors, flowmeters, gas supplies, power supplies and modules.	Otherwise, stop using the anesthesia system and contact your service personnel or Mindray.
	3. Preoperative Check List	Displays the checks to be performed before operating the system.	

Table 5-1 System Check

NOTE: Select the **[Alarms]** soft key > **[Limits]** tab on the Main Screen. Set the **[AGSS Alarms]** to  (off) or  (on) in the pop-up menu. When the **[AGSS Alarms]** is set to  (on), the System Check items include the AGSS tests. When the **[AGSS Alarms]** is set to  (off), the System Check items do not include the AGSS tests.

5.4.1 Auto System Check

Set the time for the next automatic system check.

1. Enter the standby screen, and select the  soft key > **[Auto System Check]** soft key.
2. Set the time for automatic system checks.
3. Select the **[Start]** soft key and the system enters the standby screen. The time for the next automatic system check is displayed on the standby screen.

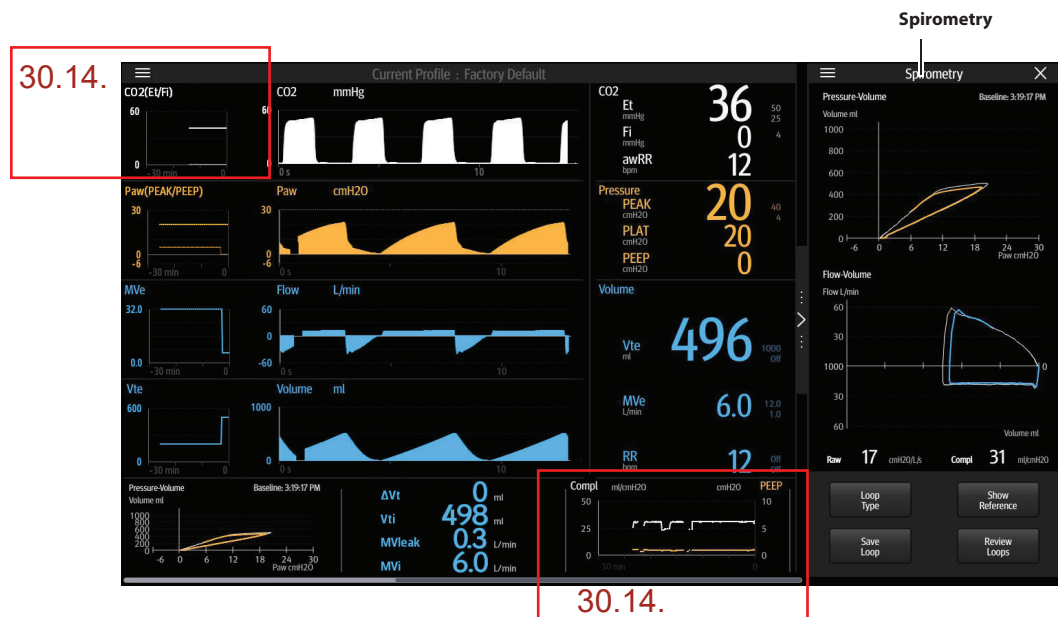


Figure 4-20 Spirometry (standard loop screen, two loops are displayed)

4.4.2.1

Loop Type

Tūrio srauto

Slėgio srauto

28.

The [Loop Type] option is used to display the P-V, the F-V, or the P-F loop on the spirometry screen.

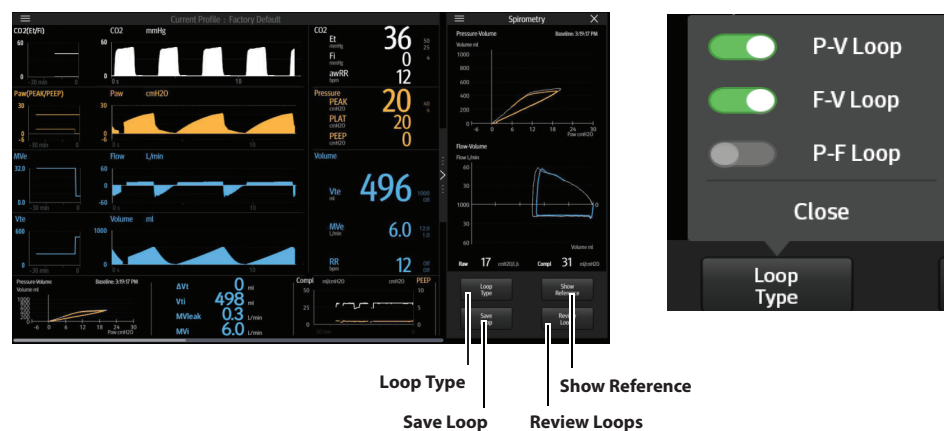


Figure 4-21 Soft keys of loops: Loop Type, Show Reference, Save Loop and Review Loops

4.4.2.2

Show Reference

Select [Show Reference] softkey only after saving a baseline via the [Save Loop] softkey.

[Show Reference] soft key is used to select and display the saved baseline loop and reference loop, or hide the loops (disable) in the loop window. The selected baseline loop or reference loop will be shown overlapped with the current loop. Only the most recent five reference loops saved will be displayed in the chronological order.

After the reference loop or baseline loop to display in the loop window are selected, the timestamp will also be displayed.

30.10.

MENU	OPTION	DESCRIPTION
Quick Key	Alarm Reset	When the [Alarm Reset] is enabled, the Main Screen will display the [Alarm Reset] soft key. When the [Alarm Reset] is disabled, the Main Screen will not display the [Alarm Reset] soft key.
	Capture Event/Screen	When the [Capture Event/Screen] is enabled, the Main Screen will display the [Capture Event/Screen] soft key. When the [Capture Event/Screen] is disabled, the Main Screen will not display the [Capture Event/Screen] soft key.
	Procedures	When this feature is enabled, the Main Screen will display the [Procedures] soft key. When this feature is disabled, the Main Screen will not display the [Procedures] soft key.
	Flow Pause	When the [Flow Pause] is enabled, the Main Screen will display the [Flow Pause] soft key. When the [Flow Pause] is disabled, the Main Screen will not display the [Flow Pause] soft key.
	Bypass in Auto mode	When the feature is enabled, the [Bypass] soft key on the Main Screen is available in both the Auto Ventilation mode and Manual Ventilation mode. When the feature is disabled, the [Bypass] soft key is only available in the Manual Ventilation mode.
AG (AG module configured)	Null for 30s from zeroing	When the feature is enabled, related parameters of AG module will be invalid within 30s of starting zeroing AG module. When the feature is disabled, related parameters of AG module will be normal within 30s of starting zeroing AG module.
	Types of Agent	Set the types of anesthetic agent which need automatic recognition.
Language/ Unit	Language	Sets the user interface text language.
	Pressure Unit	Sets the unit for pressure.
	CO ₂ Unit	Sets the unit for CO ₂ .
	Gas Supply Pressure	Sets the unit for the gas supply pressure.
	Agent Cost Unit	Sets the agent cost unit.
	Patient Height	Sets the unit for patient height.
Optimizer	Patient Weight	Sets the unit for patient weight.
	Optimizer	Enables or disables the optimizer feature.
	Agent Usage	Enables or disables the agent usage calculation feature.
History	Cost/ml of Liquid Agent	Sets the cost of anesthetic agent per ml.
	Clear History	Configure the Clear History setting at the end of the case. When this feature is enabled, the standby screen displays the [Clear History will delete all List Trends and Event Logs at the start of case!] .

Table 4-9 Setup menu

7.1 Introduction

The anesthetic gas (AG) module measures patients' anesthetic and respiratory gases and incorporates the functionalities of the O₂ module as well.

30.10.

The AG (anesthesia gas) module determines the concentrations of certain gases using the infrared (IR) light absorption measurement. The gases that can be measured by the AG module absorb IR light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurement, there are multiple IR filters. This means that higher concentration of IR absorbing gas causes a lower transmission of IR light. From the amount of IR light measured, the concentration of gas present can be calculated.

Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the sensor of the O₂ module are two nitrogen-filled glass spheres hung on a torsion device in a symmetrical magnetic field. This assembly is suspended in a symmetrical non-uniform magnetic field. In the presence of paramagnetic oxygen, the glass spheres are pushed further away from the strongest part of the magnetic field. The strength of the torque acting on the suspension is proportional to the oxygen concentration. From the strength of the torque, the concentration of oxygen is calculated.

AG measurement provides:

1. Waveform: CO₂, N₂O, O₂ and AA waveforms.
2. Measured parameters EtCO₂, FiCO₂, EtN₂O, FiN₂O, FiO₂, EtO₂, EtAA, FiAA and MAC.

Specifically, AA stands for any of the following anesthetic agents: Des (Desflurane), Iso (Isoflurane), Sev (Sevoflurane).

NOTE: If the AG module does not detect the N₂O, the monitoring value of N₂O will not be displayed on the Main Screen.

The rated respiration rate for the AG module is 2 to 100 bpm. The data sampling rate is 25 Hz. The peak value of the CO₂ waveform in the corresponding breathing cycle applies as the EtCO₂ gas reading. The peak value of the O₂ waveform in the corresponding breathing cycle applies as the O₂ gas reading. The EtN₂O and EtAA values at the time of the recorded CO₂ waveform apply as the EtN₂O and EtAA gas readings.

AG Zero Failed	Yes
EtCO ₂ Over Range	Yes
FiCO ₂ Over Range	Yes

4.3.2 Backup Flow Control System

When the EFCS fails, the system automatically opens the Backup Flow Control System (hereinafter referred to as the BFCS) cover, and adjusts the gas flow with the needle valve of flowmeter. Before the EFCS is restored, you cannot disable the BFCS.

The BFCS screen is shown in the figure below:



Figure 4-17 Backup Flow Control System

After the BFCS is enabled, the system will automatically provide O₂ flow at 1L/min. Rotate the needle valve to adjust the flow, and the flow will increase the flow from 1L/min. The total flowmeter is used to display the total flow. With the O₂ concentration displayed on the screen, you can calculate the O₂ flow and balance gas flow. By pressing the **[Audio Pause]** or **[Alarm Reset]** button, you can disable the audio alarm of **[Backup Flow Control System is enabled]**.

When the EFCS is still on, you can pull the BFCS cover outward to start the BFCS. To disable the BFCS, close all the needle valves and press the **[Disable Backup Flow Control System]** button on the screen. Then select **[Yes]** in the pop-up dialog box and close the BFCS cover to disable the BFCS.

When the **[Low Battery Voltage!]** alarm shows, the system will prompt to use the BFCS to control the flow. Please connect the system to an AC power supply as soon as possible.

4.4 Waveform/Parameter/Spirometry/Trend/Paw Gauge Display Zone

- 30.11. Displays the pressure, flow rate, volume, CO₂, O₂, N₂O, and AA waveforms; displays the monitoring parameters; displays the waveforms and monitoring parameters of the NMT module, the BIS module; displays spirometry; displays the mini trends and dual trends; displays the Paw gauge (Figure 4-18).

7.2

MAC Values 30.13.

The minimum alveolar concentration (hereinafter referred to as MAC) can be displayed on the screen when the anesthesia system is configured with external AG module.

MAC is a basic index indicating the depth of inhaled anesthesia. The ISO 80601-2-55 defines MAC as follows: alveolar concentration of an inhaled anesthetic agent that, in the absence of other anesthetic agents and at equilibrium, prevents 50% of subjects from moving in response to a standard surgical stimulus.

The following table lists 1 MAC of various inhaled anesthetic agents.

anesthetic agent	Des	Iso	Enf	Sev	Hal	N ₂ O
1 MAC	6.0%	1.15%	1.70%	2.10%	0.77%	105%*

* 1 MAC of nitrous oxide can only be reached in a hyperbaric chamber.

Table 7-1 1 MAC of various inhaled anesthetic agents

NOTE: The data shown in this table are from ISO 80601-2-55, which are published by the U.S. Food and Drug Administration for a healthy 40-year-old male patient.

NOTE: In actual applications, although the gas module accounts for patient age, the effects of weight and other factors on the inhaled anesthetic agent should be considered.

When one or more anesthetic agents are used, the formula for calculating MAC is as follow:

$$MAC = \sum_{i=0}^{N-1} \frac{EtAgent_i}{AgentVol_{age}i}$$

Where, N stands for the number of all anesthetic agents (including N₂O) which the AG module can measure, EtAgent_i stands for the end-tidal concentration of each kind of inhaled anesthetic agent, and AgentVol_{age}_i stands for the 1 MAC value corresponding to each kind of inhaled anesthetic agent after age correction.

The formula for calculating age correction of 1 MAC is as follow:

$$MAC_{age} = MAC_{40} \times 10^{(-0.00269 \times (age - 40))}$$

NOTE: The formula above is only available for patients who are older than one year old. If the patient is less than one year old, the system will use one year old to do age correction.

For example, the AG module measures that a 60-year-old patient's end-tidal concentrations of Iso is 0.9% and that of N₂O is 50%. Based on the above age correction formula, the 1 MAC value of Iso is 1.01% and that of N₂O is 92.7% for the 60-year-old patient, and the MAC value is:

$$MAC = \frac{0.9\%}{1.01\%} + \frac{50\%}{92.7\%} = 1.4$$

4.8.1.5 Export

Insert a U disk to the USB interface of the equipment as per the prompts on the screen. Select the **[Export]** soft key to export list trends, graphic trends, event logs and captured screens to the U disk. The exported data is in the format of .html. Files in the format can be opened in Internet Explorer 8.0, 9.0, 10.0 and 11.0.

4.8.2 Procedures

Select the **[Procedures]** soft key, and select **[Insp./Exp. Hold]**, **[Multi-Step Recruitment]** or **[One-Step Recruitment]** in the opened screen.

4.8.3 Flow Pause

32.

Use **[Flow Pause]** to temporarily suspend fresh gas flow during the ventilation. Using **[Flow Pause]** while the breathing system is disconnected from patient prevents the flow of gas into the room. **[Flow Pause]** is available during both mechanical ventilation and manual ventilation.

To enter the **[Flow Pause]** state:

1. On the Main Screen, select the **[Flow Pause]** soft key.
2. Select **[Yes]** on the pop-up screen to confirm the change. The system will enter the **[Flow Pause]** state.

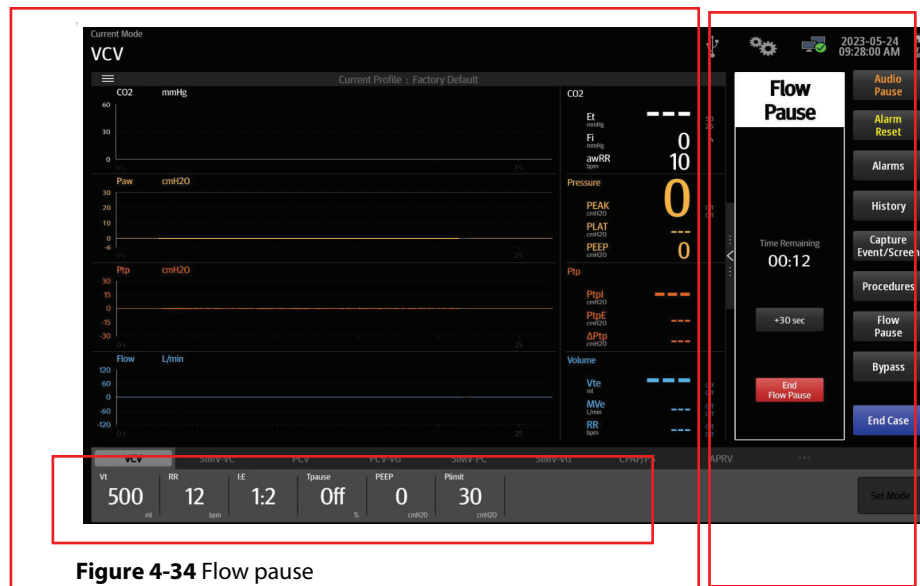


Figure 4-34 Flow pause

When the system is in the **[Flow Pause]** state:

- The fresh gas flow is turned off.
- The mechanical ventilation is suspended.
- Physiological alarms related to ventilation and gas are disabled.
- The countdown timer is enabled. The default countdown time is 60 seconds. You can select **[+30 sec]** button to add 30 seconds to the current countdown time. The maximum countdown time is 2 minutes.

To exit the **[Flow Pause]** state:

- The system exits the **[Flow Pause]** state automatically when the countdown time is 00:00.
- Select **[End Flow Pause]** button to exit the **[Flow Pause]** state.
- The system exits the **[Flow Pause]** state automatically when the system enters Standby mode or the BFCS is enabled.

A8/A9

Anesthesia System

Service Manual

6.3.5.5 APL Valve Assembly

The APL valve assembly is an adjustable pressure limit valve for setting the maximum limited pressure during manual ventilation of the anesthesia machine. The valve has a mechanical structure. When adjusting the pressure, it changes the compression rate of the internal spring to change the force of the pressure actuating device and act on the sealing valve. The structural diagram of the APL valve assembly is shown below.

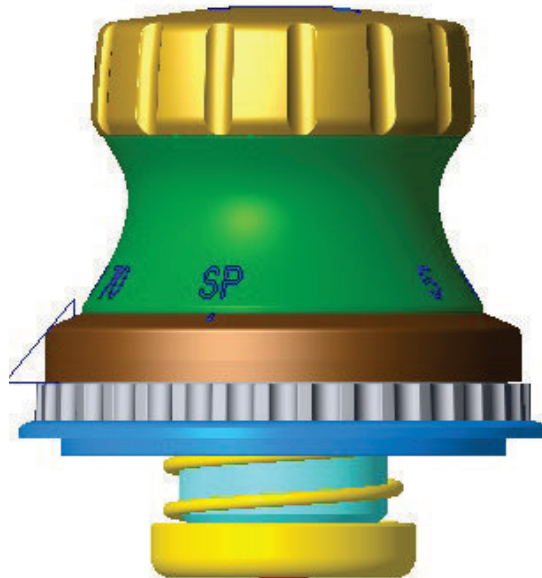


Figure 31 Structural diagram of the APL valve assembly

6.3.5.6 Absorber Canister and Bypass Assemblies

The absorber canister is used to hold the absorbent (such as soda lime). The absorbent absorbs the CO₂ exhaled by the patient during surgery, allowing the gas to circulate. When the absorber canister is removed, the valve in the bypass assembly switches, to keep the breathing system in the airtight state and allowing the mechanical ventilation of the anesthesia machine to continue.


















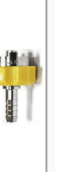
The bypass assembly is mounted to the circuit adapter assembly through a hook structure. The absorber canister assembly is assembled and disassembled by using a poppet device, which is equipped with a position switch to detect whether the absorber canister is in place.

Anesthesia accessory



CATALOGUE 2022.06

Pipeline Vacuum Hose assembly

- Gas supply: Vacuum, Hose length: 5 m; Apply to all models

Part No.	Specification	Standard	Hose color	Gas outlet (machine)	Gas inlet (wall)
082-001333-00	35U-VAC-DS/DS-5	USA	White	<div>DISS</div>	<div>DISS</div>
082-001334-00	35U-VAC-PB/DS-5			<div>DISS</div>	<div>Puritan-Bennett</div>
082-001335-00	35U-VAC-OH/DS-5			<div>DISS</div>	<div>Ohmeda</div>
082-001336-00	35U-VAC-CH/DS-5			<div>DISS</div>	<div>Chemetron</div>
082-001340-00	35U-VAC-B5/DS-5			<div>DISS</div>	<div>British standard</div>
082-001341-00	35I-VAC-B5/NS-5	ISO	Yellow	<div>NIST</div>	<div>British standard</div>
082-001339-00	35I-VAC-G5/NS-5			<div>NIST</div>	<div>Germany standard</div>
082-001337-00	35I-VAC-SIS/NS-5			<div>NIST</div>	<div>Australian SIS standard</div>
082-001338-00	35I-VAC-FS/NS-5			<div>NIST</div>	<div>French standard</div>

18.

Picture	Part No.	Description	Apply to
	040-001532-00	Vacuum Liquid collection bottle/flask, with overflow protection	All
	040-001533-00	Vacuum Liquid collection bottle/flask, without overflow protection	All



Suction tube connect the anesthesia machine and liquid collection bottles, 3m, with filters

115-033264-00

All

Central gas supply hose



33.

- Hose length 5 m
- Apply to all models

Standard: ISO

Part No.	Specification	Gas supply	Hose color	Gas outlet (machine)	Gas inlet (wall)
082-003443-00	34U-OXY-DS/DS-5	O ₂	Green	DISS	DISS
082-003445-00	34U-AIR-DS/DS-5	Air	Yellow		
082-003444-00	34U-N2O-DS/DS-5	N ₂ O	Blue		

Standard: USA

Part No.	Specification	Gas supply	Hose color	Gas outlet (machine)	Gas inlet (wall)
082-001227-00	34U-OXY-BS/DS-5	O ₂	Green	DISS	British standard
082-001228-00	34U-AIR-BS/DS-5	Air	Yellow		
082-001229-00	34U-N2O-BS/DS-5	N ₂ O	Blue		
082-001356-00	34U-OXY-CH/DS-5	O ₂	Green	DISS	Chemtron
082-001355-00	34U-AIR-CH/DS-5	Air	Yellow		
082-001354-00	34U-N2O-CH/DS-5	N ₂ O	Blue		
082-001376-00	34U-OXY-OH/DS-5	O ₂	Green	DISS	Ohmeda
082-001374-00	34U-AIR-OH/DS-5	Air	Yellow		
082-001373-00	34U-N2O-OH/DS-5	N ₂ O	Blue		
082-001375-00	34U-OXY-PB/DS-5	O ₂	Green	DISS	Puritan-Bennett
082-001378-00	34U-AIR-PB/DS-5	Air	Yellow		
082-001377-00	34U-N2O-PB/DS-5	N ₂ O	Blue		

Standard: ISO

Part No.	Specification	Gas supply	Hose color	Gas outlet (machine)	Gas inlet (wall)
082-001209-00	34I-OXY-GS/NS-5	O ₂	White	NIST 	British standard 
082-001210-00	34I-AIR-B5/NS-5	Air	Black & White		
082-001211-00	34I-N2O-B5/NS-5	N ₂ O	Blue		
082-001212-00	34I-OXY-GS/NS-5	O ₂	White	NIST 	Germany standard 
082-001213-00	34I-AIR-GS/NS-5	Air	Black & White		
082-001214-00	34I-N2O-GS/NS-5	N ₂ O	Blue		
082-001215-00	34I-OXY-SIS/NS-5	O ₂	White	NIST 	Australian SS standard 
082-001216-00	34I-AIR-SIS/NS-5	Air	Black & White		
082-001217-00	34I-N2O-SIS/NS-5	N ₂ O	Blue		
082-001218-00	34I-OXY-FS/NS-5	O ₂	White	NIST 	French standard 
082-001219-00	34I-AIR-FS/NS-5	Air	Black & White		
082-001220-00	34I-N2O-FS/NS-5	N ₂ O	Blue		

Mounting solution



BeneVision N17/N15/N12

Patient monitor

Physical Specifications

Weight	Standard configuration, excluding modules, recorder, battery and accessories.
N17:	7.3 kg (16.1 lbs)
N15:	5.4 kg (11.9 lbs)
N12:	4.1 kg (9.1 lbs)
Size	
N17:	466 x 355 x 210 mm
N15:	396 x 313 x 193 mm
N12:	313 x 290 x 161 mm

Display	36.3.1.
Type	Medical-grade color TFT LCD, capacitive touch screen, support multi-touch operation.
	178° viewing angle 36.3.3.

Screen & Resolution

N17:	18.5-inch, 1920 x 1080 pixels (FHD)	36.3.2.
N15:	15.6-inch, 1920 x 1080 pixels (FHD)	36.3.4.
N12:	12.1-inch, 1280 x 800 pixels (WXGA)	

Waveforms	N17: Up to 12 waveforms
	N15: Up to 10 waveforms 36.5.
	N12: Up to 8 waveforms

36.9.1. ECG

Meet standards of IEC 60601-2-27 and IEC 60601-2-25.

Lead Sets	Automatic 3/5/6/12 - lead recognition
3-lead:	I, II, III
5-lead:	I, II, III, aVR, aVL, aVF, V 36.10.1.
6-lead:	I, II, III, aVR, aVL, aVF, Va, Vb
12-lead:	I, II, III, aVR, aVL, aVF, V1 to V6
Sweep Speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s
Gain Selection	x 0.125, x 0.25, x 0.5, x 1, x 2, x 4, auto
Waveform format	Standard, Cabrera
Input Signal Range	± 8 mV (p-p)
Electrode Offset Potential Tolerance	± 500 mV
Bandwidth	
Diagnostic Mode:	0.05 to 150 Hz
Monitor Mode:	0.5 to 40 Hz
Surgical Mode:	1 to 20 Hz
ST Mode:	0.05 to 40 Hz
High Freq Cut-off (for 12-lead ECG analysis):	350 Hz, 150 Hz, 35 Hz, 20 Hz selectable

CMRR

Diagnostic:	> 90 dB
Monitor, Surgical, ST mode:	> 105 dB (with notch filter on)

Pace detection

Amplitude:	± 2 mV to ± 700 mV
Width:	0.1 to 2 ms
Rise time:	10 to 100 µs (without overshoot)

Defibrillator Protection Withstand 5000VAC (360J) defibrillation

Defib. Recovery Time ≤ 5 seconds

ESU recovery time ≤ 10 s

Provides Glasgow resting 12-lead ECG algorithm.

Provides Mindray Multi(4)-lead ECG monitoring analysis algorithm.

(* These ECG specifications are from MPM Platinum module.)

Heart Rate

Measurement Range

Adult:	15 to 300 bpm 36.10.2.
Pediatric/Neonate:	15 to 350 bpm

36.10.3. Accuracy ± 1 bpm or ± 1%, whichever is greater.

Resolution 1 bpm

Arrhythmia Analysis

Patient	Adult/Pediatric/Neonate.
Monitored Arrhythmias	Asystole, VFib/VTac, VTac, Vent. Brady, Extreme Tachy, Extreme Brady, Vrrhythm, PVCs/min, Pauses/min, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVC, Tachy, Brady, Missed Beats, PNP, PNC, Multif. PVC, Nonsus. VTac, Pause, Irr. Rhythm, AFib, SVT, SVTs/min

36.9.3. ST Segment Analysis

Patient	Adult/Pediatric.
Range	- 2.0 to + 2.0 mV (RTI)
Accuracy	± 0.02 mV or ± 10%, whichever is greater (- 0.8 to + 0.8 mV)
Resolution	0.01 mV



QT Analysis

Patient	Adult/Pediatric/Neonate.
Parameters	QT, QTc, ΔQTc
QTc Formula	Bazett, Fridericia, Framingham, or Hodges
Range	

QT/QTc:	200 to 800 ms
QT-HR:	Adult: 15 to 150 bpm Pediatric/Neonate: 15 to 180 bpm
QT Accuracy	± 30 ms
Resolution	QT 4 ms; QTc 1 ms

Respiration 36.9.2.

Range	0 to 200 bpm
Resolution	1 rpm
Apnea Alarm Time	10, 15, 20, 25, 30, 35, 40 sec
Accuracy	

0 - 120 rpm:	± 1 rpm
121 - 200 rpm:	± 2 rpm

Lead I, II, or auto (default: lead II)

Pulse Oximetry 36.9.6.

Meet standards of ISO 80601-2-61.

Module Mindray, Masimo, Nellcor

Range 0 to 100 %

Resolution 1%

Accuracy

36.13.2. Mindray/Nellcor:	± 2 % (70 to 100%, Adult/Pediatric); ± 3 % (70 to 100%, Neonate) Unspecified (0 to 69%)
Masimo:	± 2 % (70 to 100%, Adult/Pediatric, non-motion) ± 3 % (70 to 100%, Neonate, non-motion) ± 3 % (70 to 100%, motion) Unspecified (0 to 69%)

Perfusion indicator (PI) Yes, for Mindray/Masimo SpO₂

Pitch Tone Yes

Dual-SpO₂ Yes, SpO_{2a}, SpO_{2b}, ΔSpO₂

Pulse Rate Range

Mindray/Nellcor:	20 to 300 bpm
Masimo:	25 to 240 bpm

Pulse Rate Accuracy

Mindray:	± 3 bpm (20 - 300 bpm)
Nellcor:	± 3 bpm (20 - 250 bpm)
Masimo:	± 3 bpm (non-motion) ± 5 bpm (motion)

PR Refresh Rate 1 sec

36.9.5. Temperature

Meet standard of ISO 80601-2-56.

Method Thermal resistance

Channels Up to 8 channels iki 8 kanaly

Units of Measure Selectable °C or °F

36.12.1. Range 0 to 50 °C / 32 to 122 °F

Resolution 0.1 °C, 0.1 °F

36.12.2. Accuracy ± 0.1 °C or ± 0.2 °F (without probe)

Refresh Rate 1 sec

Genius™ Tympanic Thermometer

Measurement Range 33 to 42 °C / 91.4 to 107.6 °F

Calibrated Accuracy ± 0.1 °C (environment temperature 25 °C, target temperature 36.7 to 38.9 °C)
± 0.2 °C (environment temperature 16 °C, target temperature 33 to 42 °C)

Resolution 0.1 °C, 0.1 °F

Response Time < 2 sec

Non-Invasive Blood Pressure 36.9.4.

Meet standards of ISO 80601-2-30.

Method Oscillometry

Modes Manual, Auto, STAT, Sequence

Units of Measure mmHg, kPa (user-selectable)

Resolution 1 mmHg

Systolic range

Adult:	25 to 290 mmHg
Pediatric:	25 to 240 mmHg
Neonate:	25 to 140 mmHg

Diastolic range

Adult:	10 to 250 mmHg
Pediatric:	10 to 200 mmHg
Neonate:	10 to 115 mmHg

Mean range

36.11.2.1.

36.11.2.2.

36.11.2.3.

36.11.1.

Adult:	15 to 260 mmHg
Pediatric:	15 to 215 mmHg
Neonate:	15 to 125 mmHg

Accuracy

Max Mean Error: ± 5 mmHg 36.11.3.

Max Standard Deviation: 8 mmHg

Cuff Deflation Technique Step bleed

Initial Cuff Inflation

Adult:	80 to 280 mmHg (default: 160 mmHg)
Pediatric:	80 to 210 mmHg (default: 140 mmHg)
Neonate:	60 to 140 mmHg (default: 90 mmHg)

Over Pressure Protection

Adult/ Pediatric:	297 \pm 3 mmHg
Neonate:	147 \pm 3 mmHg

Max Measurement time

Adult/Pediatric:	180 sec
Neonate:	90 sec

Assisting Venous Puncture Yes

Pulse Rate Range 30 to 300 bpm

Pulse Rate Accuracy ± 3 bpm or ± 3 %, whichever is greater

IBP 36.9.7.

Meet standard of IEC 60601-2-34.

Number Up to 8 channels Iki 8 kanaly

Measurement Range -50 to 360 mmHg

Resolution 1 mmHg

Accuracy ± 1 mmHg or ± 2 %, whichever is greater (excluding sensor error)

Sensitivity 5 μ V/V/mmHg

Impedance Range 300 to 3000 Ω

PPV Range 0 to 50 %

PAWP Yes

ICP measurement Support

Support waveforms overlapping.

Pulse Rate Range 25 to 350 bpm

Pulse Rate Accuracy ± 1 bpm or ± 1 %, whichever is greater

Cardiac Output

Method Thermodilution

Measurement Range 0.1 - 20 L/min

Resolution 0.1 L/min

Accuracy ± 0.1 L/min or ± 5 %, whichever is greater

TB Range 23 to 43 $^{\circ}$ C / 73.4 to 109.4 $^{\circ}$ F

TB, TI Accuracy ± 0.1 $^{\circ}$ C (without sensor)

TB, TI Resolution 0.1 $^{\circ}$ C

PiCCO

Parameters	Measurement Range	Coefficient of Variation
CCO	0.25 to 25.0 L/min	≤ 2 %
C.O.	0.25 to 25.0 L/min	≤ 2 %
GEDV	40 to 4800 ml	≤ 3 %
SV	1 to 250 ml	≤ 2 %
EVLW	10 to 5000 ml	≤ 6 %
ITBV	50 to 6000 ml	≤ 3 %

(Coefficient of variation is measured using synthetic and/or database wave forms (laboratory testing.) Coefficient of variation= SD/mean error.)

TB Range 23 to 43 $^{\circ}$ C / 73.4 to 109.4 $^{\circ}$ F

TB, TI Accuracy ± 0.1 $^{\circ}$ C (without sensor)

TB, TI Resolution 0.1 $^{\circ}$ C

pArt/pCVP Range -50 to 300 mmHg

pArt/pCVP Accuracy ± 1 mmHg or ± 2 %, whichever is greater

ScvO₂

Range 0 to 99 %

Accuracy ± 3 % (50 to 80 %)

ICG

Method Thoracic electrical bioimpedance (TEB)

HR Range 40 to 200 bpm (ICG), accuracy ± 2 bpm

C.O. Range 1.0 to 15 L/min

SV Range 5 to 250 ml

Provides Monitoring Parameters ACI, VI, PEP, LVET, TFI, TFC, HR, C.O., C.I., SV, SVI, SVR, SVRI, PVR, PVRI, LCWI, LVSW, LVSWI, STR, VEPT

Continuous Cardiac Output Interface

Measured Parameter Consistent with CCO-related parameters outputted by Vigilance II[®], Vigileo™, EV1000 or HemoSphere

Artema Sidestream CO₂

Meet standard of ISO 80601-2-55.

Measurement Range

etCO ₂ :	0 to 150 mmHg
O ₂ (optional):	0 to 100 %

CO₂ Accuracy

0 to 40 mmHg:	± 2 mmHg
41 to 76 mmHg:	± 5 % of reading
77 to 99 mmHg:	± 10 % of reading
100 to 150 mmHg:	$\pm (3 \text{ mmHg} + 8\% \text{ of reading})$

O₂ Accuracy

0 to 25 %:	± 1 %
------------	-----------

25.1 to 80 %: ± 2 %

80.1 to 100 %: ± 3 %

Resolution

etCO₂: 1 mmHg

O₂ (optional): 1 %

Sample Flow Rate

Adult/Pediatric:	120 ml/min (with or without O ₂ monitoring)
Neonate:	70 ml/min or 90 ml/min, selectable 90 ml/min (with O ₂ monitoring)

Sample Flow Rate Tolerance

± 15 ml/min or ± 15 %, whichever is greater.

Warm-up Time

90 sec (maximum), 20 sec (typically)

Measured with a neonatal watertap and 2.5-meter neonatal sampling line, or an adult watertap and a 2.5-meter adult sampling line:

Rise Time

etCO ₂ :	≤ 250 ms @ 70 ml/min (Neonate watertap) ≤ 250 ms @ 90 ml/min (Neonate watertap) ≤ 300 ms @ 120 ml/min (Adult watertap)
O ₂ (optional):	≤ 800 ms @ 90 ml/min (Neonate watertap) ≤ 750 ms @ 120 ml/min (Adult watertap)

Sampling Delay Time

etCO ₂ :	≤ 5.0 sec @ 70 ml/min (Neonate watertap) ≤ 4.5 sec @ 90 ml/min (Neonate watertap) ≤ 5.0 sec @ 120 ml/min (Adult watertap)
O ₂ (optional):	≤ 4.5 sec @ 90 ml/min (Neonate watertap) ≤ 5.0 sec @ 120 ml/min (Adult watertap)

awRR Range

0 to 150 rpm

awRR Accuracy

0 to 60 rpm:	± 1 rpm
61 to 150 rpm:	± 2 rpm

Apnea Time

10, 15, 20, 25, 30, 35, 40 sec

Provide VCO₂, VO₂, MVCO₂, MVO₂, EE, RQ parameters, when monitoring with RM module.

Oridion Microstream CO₂

Measurement Range 0 to 99 mmHg

Resolution 1 mmHg

Accuracy

0 to 38 mmHg:	± 2 mmHg
39 to 99 mmHg:	± 5 % + 0.08 % of the reading - 38 mmHg

Sample Flow Rate 50 $^{-7.5, +15}$ ml/min

Start-up Time 30 sec (typical)

Response Time 2.9 s (typical)

awRR Range 0 to 150 rpm

awRR Accuracy

0 to 70 rpm:	± 1 rpm
71 to 120 rpm:	± 2 rpm
121 to 150 rpm:	± 3 rpm

Apnea time 10, 15, 20, 25, 30, 35, 40 sec

Capnostat Mainstream CO₂

Measurement Range 0 to 150 mmHg

Resolution 1 mmHg

Accuracy

0 to 40 mmHg:	± 2 mmHg
41 to 70 mmHg:	± 5 % of reading
71 to 100 mmHg:	± 8 % of reading
101 to 150 mmHg:	± 10 % of reading

Rise time < 60 msec

awRR Range 0 to 150 rpm

awRR Accuracy ± 1 rpm

Provide VCO₂, MVCO₂, FeCO₂, SlopeCO₂, Vtalv, MValv, Vdaw, Vdaw/Vt, Vdalv, Vdalv/Vt, Vdphy, Vd/Vt, when monitoring with RM module.

Anesthesia Gases

Meet standard of ISO 80601-2-55.

Sampling Rate

Adult/pediatric:	200 ml/min
Neonate:	120 ml/min

Sampling Rate Tolerance ± 10 ml/min or ± 10 %, whichever is greater.

Sampling Delay Time < 4 sec

Refresh Rate 1 sec

Warm-up Time 45 sec to warm-up status

10 min to ready-to-measure status

Measurement Range

CO ₂ :	0 to 30 %
N ₂ O:	0 to 100 %
Des/Sev/Enf/Iso/Hal:	0 to 30 %
O ₂ :	0 to 100 %
awRR:	2 to 100 rpm

Resolution

CO ₂ :	0.1 %
N ₂ O:	1 %
Des/Sev/Enf/Iso/Hal:	0.1 %
O ₂ :	1 %

awRR:	1 rpm	
Full Accuracy		
Gases	Range (%REL)	Accuracy (%ABS)
CO ₂ :	0 to 1 %	± 0.1 %
	1 to 5 %	± 0.2 %
	5 to 7 %	± 0.3 %
	7 to 10 %	± 0.5 %
	> 10 %	Not specified
N ₂ O:	0 to 20 %	± 2 %
	20 to 100 %	± 3 %
Des:	0 to 1 %	± 0.15 %
	1 to 5 %	± 0.2 %
	5 to 10 %	± 0.4 %
	10 to 15 %	± 0.6 %
	15 to 18 %	± 1 %
	> 18 %	Not specified
Sev:	0 to 1 %	± 0.15 %
	1 to 5 %	± 0.2 %
	5 to 8 %	± 0.4 %
	> 8 %	Not specified
Enf/Iso/Hal:	0 to 1 %	± 0.15 %
	1 to 5 %	± 0.2 %
	> 5 %	Not specified
O ₂ :	0 to 25 %	± 1 %
	25 to 80 %	± 2 %
	80 to 100 %	± 3 %
awRR:	2 to 60 rpm	± 1 rpm
	> 60 rpm	Not specified
Rise Time		
Sampling flow 120 ml/min, using the DRYLINE II™ watertrap and a neonatal 2.5m sampling line,		
CO ₂ / N ₂ O:	≤ 250 ms	
Iso/Hal/Sev/Des:	≤ 300 ms	
Enf:	≤ 350 ms	
O ₂ :	≤ 600 ms	
Sampling flow 200ml/min, using DRYLINE II™ watertrap and an adult 2.5m sampling line:		
CO ₂ / N ₂ O:	≤ 250 ms	
Iso/Hal/Sev/Des:	≤ 300 ms	
Enf:	≤ 350 ms	
O ₂ :	≤ 500 ms	
Sampling Delay Time		
Sampling flow 120 ml/min, using the DRYLINE II™ watertrap and a neonatal 2.5m sampling line,		
CO ₂ :	≤ 4 sec	
N ₂ O:	≤ 4.2 sec	
O ₂ :	≤ 4 sec	
Enf /Iso/Hal/Sev/Des:	≤ 4.4 sec	
Sampling flow 200ml/min, using DRYLINE II™ watertrap and an adult 2.5m sampling line:		
CO ₂ :	≤ 4.2 sec	
N ₂ O:	≤ 4.3 sec	
O ₂ :	≤ 4 sec	
Enf/Iso/Hal/Sev/Des:	≤ 4.5 sec	
Apnea time	10,15,20,25,30,35,40 sec	
Provide MAC value (support calibrated by age).		
Support two mixed gas identify and monitoring.		
RM		
Method	Diff-Pressure flow	
Measurement Range		
Flow	Adult/Pediatric: ± (2 to 120) L/min	
	Neonate: ± (0.5 to 30) L/min	
Paw	-20 to 120 cmH ₂ O	
MVe/MVi	Adult/Pediatric: 2 to 60 L/min	
	Infant: 0.5 to 15 L/min	
TVe/TVi	Adult/Pediatric: 100 to 1500 ml	
	Infant: 20 to 500 ml	
awRR range	4 to 120 rpm	
Resolution		
Flow	0.1 L/min	
Paw	0.1 cmH ₂ O	
MVe/MVi	0.01 L/min (MVe/MVi < 10 L/min)	
	0.1 L/min (MVe/MVi ≥ 10 L/min)	
TVe/TVi	1 ml	
awRR:	1 rpm	
Accuracy		
Flow	Adult/Pediatric: ± 1.2 L/min or ± 10% of the reading, whichever is greater.	
	Neonate: ± 0.5 L/min or ± 10%, whichever is greater.	
Paw	± 3% of reading	
MVe/MVi	± 10% of reading	
TVe/TVi	Adult/Pediatric: ±10% or ±15 ml, whichever is greater.	

awRR:	Infant: ±10% or ±6 ml, whichever is greater. ±1 rpm (4 to 99 rpm) ±2 rpm (100 to 120 rpm)
Provide loops display.	
Monitoring parameters include PEEP, Pmean, PIP, Pplat, PEF, PIF, MVe, MVi, TVe, TVi, RR, I:E, FEV1.0, Compl, RSBI, NIF, WOB, RAW.	
rSO ₂	
Patient	Adult/Pediatric/Neonate.
Method	INVOS, NIRS (Near Infrared Spectroscopy)
Number	Up to 4 channels
Measurement Range	15 to 95 %
NMT	
Meet the standard of IEC 60601-2-10	
Sensor Type	Acceleromyography sensor
Stimulation Modes	ST, TOF, PTC, DBS3.2, DBS3.3
Stimulation Current Range	0 to 60 mA
Stimulation Current Accuracy	± 5% or ±2 mA, whichever is greater.
Stimulation Pulse Width	100,200 or 300µs, monophasic rectangle pulse
Stimulation Pulse Width Accuracy	± 10 %
Max. Output Voltage	300 V
BISx/BISx4	
Meet standard of IEC 60601-2-26.	
Method	Bispectral Index
Impedance Range	0 to 999 kΩ
EEG Bandwidth	0.25 to 100 Hz
BIS Range	0 to 100 (BIS, BIS L, BIS R)
SQI Range	0 to 100 % (SQI, SQI L, SQI R)
ASYM	0 to 100%
DSA Trend	Yes
EEG/aEEG	
Meet standard of IEC 60601-2-26.	
EEG Channels	Up to 4 channels
Montage Mode	Biopolar mode, referential mode
Input Signal Range	- 2 mVp-p to + 2mVp-p
Max. Input DC Offset	± 500 mV
CMRR	≥ 100 dB @51 kΩ imbalance and 60 Hz
Noise Level	≤ 0.5 µV rms (0.5 Hz to 70 Hz)
Differential Input Impedance	> 15 MΩ @10 Hz
Electrode Impedance	
Range	1 to 90 kΩ
Accuracy	± 1 kΩ or ± 10%, whichever is greater
Sampling Frequency	EBN EEG: 1024 Hz Mindray EEG: 256Hz
Analog bandwidth	EBN EEG: 0.5 to 110 Hz Mindray EEG/aEEG: 0.1 to 110 Hz
Spectrum analysis	SEF, MF, PPF, TP, SR, EMG, Delta, Theta, Alpha, Beta
Trend	DSA, CSA
ANI	
Patient	Adult, Pediatric (over 12 years old)
Measurement Range	ANli: 12 to100 ANlm: 12 to 100 Energy: 0.00 to 65.54
tcGas	
Interfaces with TCM CombiM, TCM TOSCA or SenTec SDM monitor.	
Measurement Range	
tcpCO ₂	5 to 200 mmHg
tcpO ₂	0 to 800 mmHg
SpO ₂	0 to 100 %
PR	25 to 240 bpm
Power	0 to 1000 mW
Accuracy	
tcpCO ₂	TOSCA Sensor 92, tc Sensor 54: Better than 1 mmHg (1 % or 10 % CO ₂) Better than 3 mmHg (33 % CO ₂) tc Sensor 84: Better than 1 mmHg (1 % or 10 % CO ₂) Better than 5 mmHg (33 % CO ₂)
tcpO ₂	tc Sensor 84: Better than 1 mmHg (0 % O ₂) Better than 3 mmHg (21 % O ₂) Better than 5 mmHg (50 % O ₂) Better than 25 mmHg (90 % O ₂) ±3 % (70 to 100 %) ±3 bpm ±20 % of reading
SpO ₂	
PR	
Power	
iView (for N17 only)	
CPU	Intel Pentium N4200 2.5GHz
Memory	8 GB
Hard-disk	mSATA SSD 128GB
OS	Windows 10

Recorder

Type	Thermal array
Speed	25 mm/sec, 50 mm/sec
Trace	Up to 3 (paper 50 mm width, 20 m length)
Supports integrated recorder module.	

Alarms

Audible indicator	Yes, 4 different alarm tones, and prompt tone
Visible indicator	Red/yellow/cyan LED, and alarm message
Provide AlarmSight infographic alarm indicator.	
Support iAlarm features (alarm limits recommendations, etc.)	
Support iStatus combined alarms	

Data Storage

Trends Data	> 120 hrs @ 1min, 4 hrs @ 5 sec.
Events	1000 events, including parameter alarms, arrhythmia events, technical alarms, and so on.
NIBP	1000 sets
Interpretation of resting	12-lead ECG results 20 sets
Full disclosure	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms.
OxyCRG	48 hrs
ST review	120 hrs @ 1 min
Minitrend	Yes

Special Functions

Clinical Assistive Application (CAA):	
HemoSight™, ST Graphic™, SepsisSight™, BoA Dashboard™, EWS, GCS, ECG 24h Summary, Pace View, AF Summary, NeuroSight	

Support calculations (drug, hemodynamic, Oxygenation, Ventilation, Renal), and Titration table.

Support wireless connection with BeneVision TM80 and BP10.

Support nView remote display tool

Wi-Fi Communications

Protocol	IEEE 802.11a/b/g/n
Modulation Mode	DSSS and OFDM
Operating Frequency	
IEEE 802.11b/g/n (2.4G):	
ETSI/FCC/KC:	2.4 to 2.483 GHz
MIC:	2.4 to 2.495 GHz
IEEE 802.11a/n (5G):	
ETSI:	5.15 to 5.35 GHz, 5.47 to 5.725 GHz
FCC:	5.15 to 5.35 GHz, 5.725 to 5.82 GHz
MIC:	5.15 to 5.35 GHz
KC:	5.15 to 5.35 GHz, 5.47 to 5.725 GHz, 5.725 to 5.82 GHz

Channel Spacing	5 MHz @ 2.4 GHz (802.11 b/g/n) 20 MHz @ 5 GHz (802.11 a/n)
Wireless Baud Rate	IEEE 802.11a: 6 to 54 Mbps IEEE 802.11b: 1 to 11 Mbps IEEE 802.11g: 6 to 54 Mbps IEEE 802.11n: 6.5 to 72.2 Mbps
Output Power	< 20dBm (CE requirement: detection mode- RMS) < 30dBm (FCC requirement, detection mode- peak power)
Operating Mode	Infrastructure
Data Security	WPA-PSK, WPA2-PSK, WPA-Enterprise, WPA2-Enterprise (EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP-MSCHAPv2, PEAP-TLS, LEAP) Encryption: TKIP and AES

Output

Auxiliary Output	
Standard	Meets the requirements of ANSI/AAMI/IEC 60601-1 for short-circuit protection and leakage current

ECG Analog Output

Bandwidth (-3 dB; reference frequency: 10 Hz)	
Diagnostic Mode:	0.05 to 150 Hz
Monitor Mode:	0.5 to 40 Hz
Surgical Mode:	1 to 20 Hz
ST Mode:	0.05 to 40 Hz
QRS Delay	≤ 25 ms (in diagnostic mode, and non-paced)

Sensitivity	1 V/mV, ± 5 %
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Pace Enhancement

Signal Amplitude:	$V_{oh} \geq 2.5 V$
Pulse Width:	10 ms ± 5 %
Signal Rising and Falling Time:	≤ 100 μs

IBP Analog Output

Bandwidth (-3 dB; reference frequency: 10 Hz)	
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0 to 40 Hz

Max. Transmission Delay 30 ms

Sensitivity	1 V/100 mmHg, ± 5 %
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Interfacing

AC Power Connector	1
RJ45 Network Connector, 100 Base-TX, IEEE 802.3	36.7.2.

N17: 2 (1 for iView)

N15/N12: 1

USB 2.0 Connector

N17: 8 (4 for iView)

N15/N12: 4 36.7.1.

Nonstandard USB SMR Connector

N17/N5: 1 to connect SMR, N1/T1 docking station

N12: 1 to connect N1/T1 docking station

Standard DVI-D Video Interface Connector

N17: 2 (1 for iView)

N15/N12: 1

BNC Connector

1

Equipotential Grounding Terminal

1

Multifunction Connector for Defib Sync and Analog Output

1 on multi-parameter module

Module Slot

N17/N15: 6 slots

N12: 4 slots

Barcode Scanner

Support 1D and 2D barcode

Keyboard & Mouse

Support wire and wireless type via USB

Remote Control

Support

Network Printer

Support

Battery

36.2.2. Type Rechargeable lithium-ion

Number of Battery 1

Capacity 4500mAh

Run Time when powered by a new fully-charged battery at 25 °C±5 °C with 5-lead ECG, SpO2, and auto NIBP measurements every 15 min, and screen brightness set to 1.

36.2.3. N17/N15: > 2 hrs 2 hrs = 120 min

N12: > 4 hrs

Recharge Time 4.5 hrs to 90% when the monitor is off.

Power Requirements

36.2.1. AC Voltage 100 to 240 VAC (±10 %)

Current 2.0 to 0.9 A

Frequency 50 Hz/60 Hz (±3 Hz)

Environmental requirements

Temperature Operating: 0 to 40 °C (32 to 104 °F)

Storage: -20 to 60 °C (-4 to 140 °F)

Humidity

Operating: 15 to 95 % (non condensing)

Storage: 10 to 95 % (non condensing)

Barometric

Operating: 427.5 to 805.5 mmHg (57.0 to 107.4 kPa)

Storage: 120 to 805.5 mmHg (16.0 to 107.4 kPa)

Safety

Type of Protection Class I

Degree of Protection MPM/IBP/C.O./NMT/(a)EEG/PiCCO/ANI module: CF
ScvO2/CO2/AG/ICG/BIS/RM/rSO2 module: BF

Protection Against Ingress of Fluids

IPX1

Some of functions marked with an asterisk may not be available. Please contact your local Mindray sales representative for the most current information.

www.mindray.com

P/N:ENG- BeneVision N17/N15/N12 Datasheet-210285x4P-20211225

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mindray
healthcare within reach

BeneVision

See more With ease

N17/N15/N12

Patient Monitor



User experience enhanced by leading technologies

BeneVision N17/N15/N12

We continually dedicate ourselves to improving clinical safety and efficiency, which, we believe, can be achieved with excellent operational design. With state-of-the-art screen technology, BeneVision™ N-Series patient monitors deliver clear, multi-color, wide-format displays for users to capture and review information at a glance. With multi-touch operation, users can control the monitor and review patient data quickly and easily.



HD display



The N17 and N15 provide a 1920x1080 HD view

Wide viewing angle



N-Series monitors can be viewed from virtually any angle

Auto brightness



Displays adapt to ambient light automatically

Flat UI



Intuitive operation can reduce training time and speed workflow

Multi-touch operation



Display layout can be changed with simple swipe gestures

Clinical insight improved by professional applications

Everyday, Mindray delivers accurate, real-time, physiological measurement data from millions of patients worldwide, which clinicians have come to rely on when making clinical decisions. BeneVision N-Series provides the world's best monitoring technologies for you, with new applications being developed.

Cardiology

- Patented CrozFusion™ algorithm for accurate ARR detection
- ST monitoring and ST segment templates
- Real-time QT/QTc measurement
- Glasgow 12-lead resting interpretation

Hemodynamics and volumetric

- Classic CO₂ measurement with the SwanGanz catheter
- Less-invasive PiCCO and FloTrac monitoring
- Non-invasive cardiac output with ICG module
- Integrated CCO module with Edwards machine

Airway gas and lung mechanics

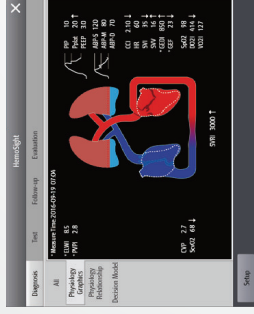
- One-slot CO₂+O₂ module
- Volumetric CO₂ and metabolic measurements
- AION Multi-Gas +SPIRiT respiratory mechanics

Tissue perfusion

- INVOS rSO₂ module for regional oxygen saturation measurement
- Patented CQI Index to indicate CPR resuscitation quality of the patient

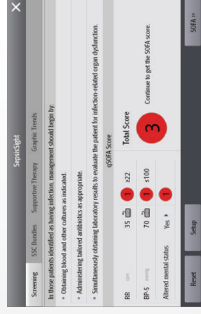
Neurology

- 4 channels EEG/aEEG
- BIS/BISx4
- Advanced NMT
- ANI module for analgesia monitoring



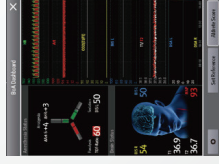
HemoSight™

Helps clinicians make decisions through sets of haemodynamic assistive applications.



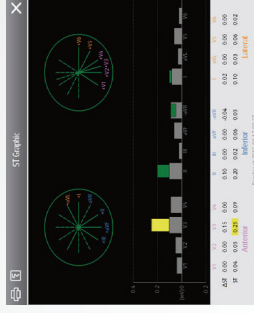
SepsisSight™

Provides a checklist to help clinicians screen, diagnose and treat septic patients according to the SSC guidelines.



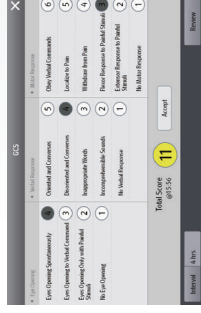
BoA Dashboard™

Helps to achieve optimal anaesthesia throughout the peri-operative period.



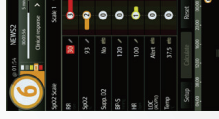
ST Graphic™

Helps clinicians to quickly assess ST segment elevations and depressions.



GCS

Glasgow Coma Scale. Records the consciousness level of patients for initial as well as subsequent assessments.



EWS

Early Warning Score. Helps with recognizing patients whose physiological conditions are at risk of deterioration.

Solutions optimized for each point of care

Mindray provides a flexible solution for monitoring your patient's status anywhere, anytime, even on your way through mobile devices. At every point of care, such as ICU, CCU, NICU, OR, PACU, ER, BeneVision N-Series patient monitors always provide a suitable solution to meet your clinical needs. You can customize the monitor for a specific patient or for acuity requirements.



With Mindray's excellent transport solution, patient data can be seamlessly transferred between patient monitors. N series patient monitor brings a smooth workflow and safe data management through the entire care process.



All details are designed to help medical staff focus on patients. Flat UI, more hotkeys, remote control, barcode scanner, etc., BeneVision takes less time to operate, and helps you understand the patient's variables quickly.



With HL7, N-Series patient monitors can directly connect to the hospital clinical network. Comprehensive clinical data from the monitor as well as BeneLink-connected devices is sent directly to your EMR/HIS. Or the patient information is sent to monitor through ADT.



As a portable compact patient monitor, the N12 is capable of monitoring multiple parameters simultaneously both at bedside and during transport.

IT structure designed for seamless connectivity

Based on Layer 3 network structure, Mindray patient monitoring system incorporate extensive network adaptability to integrate with the hospital's current network infrastructure, ensuring that critical data is on hand for clinical decision making-and is integrated with the patient record.

BeneVision patient monitors provide seamless integration with other bedside devices, such as ventilators, anesthesia systems, and infusion pumps, through the BeneLink module. Mindray's central station and eGateway further enhances the connectivity of BeneVision to your clinical world. Bedside devices data and other clinical systems data are shared to support your diagnosis and clinical decisions.

iView can run your own clinical applications (such as PACS, LIS, HIS/CIS, and EMR) on one intuitive view and connect with the hospital network infrastructure directly without any additional server or gateway.

