WATO EX-65 Pro

Anesthesia System

Physical Specifications

Dimensions and Weight

Height	1370 mm
Width	780 mm (not including breathing system) 945 mm (including breathing system)
Depth	690 mm
Weight	<145 kg (without vaporizers and cylinders)

Top Shelf

Weight limit	30 kg
Width	305 mm
Length	545 mm

Work Surface

Height	850 mm
Area	1635 cm^2

Drawer (3Xdrawers, Internal Dimension)

Height	130 mm
Width	415 mm
Depth	320 mm

Bag Arm

Height	1150 mm
Length	312 mm
Connection	ISO 22mm OD, 15mm ID

Casters

Diameter	125 mm
Brakes	Center brake system with Lock / Unlock icons

Ventilator Specifications

Modes of Ventilation

Manual/Spontaneous Ventilation/Bypass
Volume Control Ventilation (VCV) with PLV function
Pressure Control Ventilation (PCV) with/without volume guarantee (VG)
Synchronized Intermittent Mandatory Ventilation
(SIMV-Volume Controlled and SIMV-Pressure Controlled)
Pressure Support Ventilation (PS) with apnea backup
Synchronized Intermittent Mandatory Ventilation Volume Guarantee
(SIMV-VG)
Continuous Positive Airway Pressure/Pressure Support Ventilation
(CPAP/PS)
Airway Pressure Release Ventilation (APRV)

Compensation

Circuit gas leakage compensation and automatic compliance
compensation

Ventilation Parameters Range

Patient Size	Adult, Pediatric, Neonate
Tidal volume	10~1500 mL (Volume Mode) 5~1500 mL (Pressure Mode)
Pinsp	5~80 cmH_2O
Plimit	10~100 cmH_2O
ΔPsupp	3~60 cmH_2O 0, 3~60 cmH_2O (CPAP/PS)
Rate	2~100 bpm
I:E	4:1 - 1:8
Inspiratory pause (Tip:Ti)	OFF, 5% - 60%
Inspiratory time (Tinsp)	0.2 - 10.0 s
Trigger window	5% - 90%
Flow trigger	0.2 ~ 15 L/min
Pressure trigger	-20~ -1 cmH_2O
Expiration termination level	5% - 80%
Minimum Rate	2 - 60 bpm
Tslope	0.0 - 2.0 s
Apnea I: E	4:1~1:8
ΔPapnea	3 - 60 cmH_2O
Phigh	3 - 80 cmH_2O
Plow	OFF, 3 to 30 cmH2O
Thigh	0.2 to 10.0s
Tlow	0.2 to 10.0s

Positive End Expiratory Pressure (PEEP)

Type	Integrated, electronic controlled
Range	OFF, 3~30 cmH_2O

Ventilator Performance

Driving pressure	280 kPa to 600 kPa
Peak gas flow	180 L/min + Fresh Gas Flow

Monitoring Parameters

Minute volume	0 ~ 100 L/min
Tidal volume	0~3000 ml
Inspired oxygen (FiO_2)	18% ~ 100%
Airway pressure	-20 ~ 120 cmH_2O
I:E	50:1 ~ 1:50
Rate	0 ~120 bpm
PEEP	0 ~ 70 cmH_2O
Resistance (R)	0 ~ 600 cmH_2O/(L/s)
Compliance (C)	0 ~ 300 ml/cmH_2O
Elasticity (E)	0.003 to 10 hPa/mL(cmH2O/mL)

Control Accuracy

Volume delivery	5 mL to 60 mL: ±10 mL 60 mL to 210 mL: ±15 mL 210 mL to 1500 mL: ± 7% of the set value
Pressure	Pinsp, Plimit, ΔPsupp, ΔPapnea, Phigh, Plow ± 2.5 cmH_2O or ± 7% of the set value, whichever is greater
PEEP	OFF: ± 3.0 cmH_2O 3 to 30 cmH_2O: ± 2.0 cmH_2O, or ± 8% of the set value, whichever is greater
Rate	± 1bpm or ± 10% of the set value, whichever is greater
I:E	2:1 to 1:4: ± 10% of the set value Other range: ± 25% of the set value
Tip:Ti	± 8%
Tinsp	± 0.2s
Thigh	± 0.2s or ± 10% of the set value, whichever is greater
Tlow	± 0.2s or ± 10% of the set value, whichever is greater
Trigger Window	± 10%
Flow Trigger	± 1L/min
Pressure Trigger	± 2cmH_2O
Exp%	± 10%

Monitoring Accuracy

Volume monitoring	0 to 60 mL: ± 10 mL 60 to 210 mL: ± 15 mL 210 to 3000 mL: ± 7% of the real reading
Pressure monitoring	± 2.0 cmH_2O or ± 4% of the real reading, whichever is greater
Rate	± 1bpm or ± 5% of the real reading, whichever is greater
I:E	2:1 to 1:4: ± 10% of the reading Other range: no defined.
MV	± 0.1L/min or ± 8% of the real reading, whichever is greater
O2 concentration	± (2.5% of volume percentage + 2.5% of gas concentration)

Trend Graph

Continuous trend information with time discrete events for the latest 48 hours

Trend Table

Continuous trend information together with time discrete events for the latest 48 hours

Alarm Log Book

500 events storage, first in first out

Alarm setting

Tidal volume	Low: 0 ~ 1595 ml High: 5 ~ 1600 ml
Minute volume	Low: 0 ~ 99 L/min High: 0.2 ~ 100 L/min
Inspired oxygen	Low: 18% ~ 98% High: OFF, 20% ~ 100%
Apnea alarm	VTe < 10ml measured in 20s Paw < (PEEP + 3) cmH_2O in 20s
Airway pressure low	0 ~98 cmH_2O
Airway pressure high	2 ~100 cmH_2O

Sustained airway pressure alarm: 15s

Subatmospheric pressure alarm: Paw < -10 cmH_2O

Alarm silence countdown timer: 120 to 0 seconds

Lung Recruitment Tool

Maneuver	Multi-Step and One-Step Recruitment
One-Step Recruitment	Pressure Hold: 20 to 60 cmH_2O Hold Time: 10 to 40s PEEP on Exit: Off, 3 to 30 cmH_2O
Multi-Step Recruitment	Increasing PEEP progressively (with a maximum of 7 stages)

Ventilator Components

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

Ventilator Screen

Display type	Color capacitive touch screen
Display size	15 inch
Pixel format	1024 x 768
Brightness	Adjustable
Screen display	configurable
Display parameters	All setting and alarm parameters (including Breath rate, I/E ratio, Tidal volume, Minute volume, PEEP, MEAN, PEAK, PLAT, and O_2 concentration, $EtCO_2$, N_2O, Aesthesia gas concentration, BIS)
Display waveforms	P-T, F-T, V-T, CO_2, BIS, O_2, Anesthetic gas, N_2O
Spirometry loops	P-V, F-V and F-P
Timer	On screen timer

Communication Ports

One RS-232C connector and one DB9 connector

Ethernet (RJ-45)

USB

VGA

Vaporizers

Vaporizer	Mindray V60 Anesthetic Vaporizer or Penlon Sigma Delta Anesthetic Vaporizer
Support agents	Halothane, Enflurane, Isoflurane, Sevoflurane
Position	MAX.2
Mounting mode	Selectatec®, with interlocking function Plug-in®, with interlocking function

Modules

Anesthesia Gas (AG) Module

Monitor gases	CO_2, N_2O, Halothane, Enflurane, Isoflurane, Sevoflurane, Desflurane, MAC, Paramagnetic O_2 (optional)
Warm-up time	45 s (ISO accuracy mode) 10min (full accuracy mode)
Pump rate	Adu/Ped: 150, 180, 200 ml/min Neo: 100, 110, 120 ml/min
Range	CO_2: 0% ~ 10% Des: 0% ~ 18 % Sev: 0% ~ 8% Enf, Iso, Hal: 0% ~ 5% O_2/N_2O: 0% ~ 100%

Carbon Dioxide (CO_2) Modules

Method	Infrared absorption
Module type	Mindray side-stream Capnostat mainstream Oridion micro-stream (optional)
Work mode	Standby or measurement
Displayed numerics	$EtCO_2$, $FiCO_2$
Waveform	Capnography

Side-Stream Carbon Dioxide (CO_2) Module

Measurement range	0 ~ 152 mmHg
Accuracy	±2 mmHg (0 ~ 40 mmHg) ± 5% of the real reading (41 ~ 76 mmHg) ± 10% of the real reading (77 ~152 mmHg))
Resolution	1 mmHg
Pump rate	Neonatal: 100 mL/min or 120 mL/min Adult/children: 120 mL/min or 150 mL/min
Warming-up time	< 1 min, enter the ISO accuracy mode After 1 min, enters the full accuracy mode
Response time	<5 s@100 mL/min <5 s@120 mL/min Measured by using neonatal watertrap and 2.5 m neonatal sampling line <6.5 s@120 mL/min <6 s@150 mL/min Measured by using adult watertrap and 2.5 m adult sampling line

Mainstream CO_2 Module

Measurement range	0 ~ 150 mmHg
Accuracy	± 2 mmHg (0 ~ 40 mmHg) ± 5% of the reading (41 ~ 70 mmHg) ± 8% of the reading (71 ~ 100 mmHg) ± 10% of the reading (101 ~ 150 mmHg)
Resolution	1 mmHg
Response time	<2 s
Alarm limit	$EtCO_2$ High: OFF, 2 ~ 150 mmHg

	$EtCO_2$ Low: OFF, 0 ~ 148 mmHg
	$FiCO_2$ High: OFF, 1 ~ 150 mmHg

Micro-stream CO_2 Module

Measurement range	0 ~ 99 mmHg
Accuracy	0 ~ 38 mmHg: ± 2 mmHg
	39 ~ 99 mmHg: ± (5 % of the reading + 0.08 % of (the reading minus 38 mmHg))
Sampling rate	50 ml/min
Sampling accuracy	-7.5 ml/min ~ + 15 ml/min
Initialization time	30s
Response time	≤2.9s
Rising time	≤190 ms
Alarm range	$EtCO_2$ High: OFF, 2 ~ 99 mmHg
	$EtCO_2$ Low: OFF, 0 ~ 97 mmHg
	$FiCO_2$ High: OFF, 1 ~ 99 mmHg

BIS Module

Measured parameters	EEG
BIS/BIS L, BIS R	0 ~ 100
Sweep speed	6.25 mm/s,12.5 mm/s, 25 mm/s or 50 mm/s
Alarm limit	BIS high: 2 ~ 100
	BIS low: 0 ~ 98
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

Agent consumption calculation

Calculation range	0 to 3000 ml
Accuracy	± 2 mL, or ± 15% of the real reading, whichever is larger

Agent consumption speed

Anesthetic agents	Desflurane, Enflurane, Isoflurane, Sevoflurane and Halothane
Consumption speed	Desflurane: 0 ~ 900 ml/h
	Sevoflurane: 0 ~ 450 ml/h
	Enflurane, Isoflurane and Halothane: 0 ~ 250 ml/h
Accuracy	± 2ml/h or ±15% of the real reading, whichever is greater

Anesthetic Prediction

Patient Type	Height: 150 to 200 cm
	Weight: 40 to 140 kg
	Age: 18 to 90 years old
Anesthetic Agents	Desflurane, Enflurane, Isoflurane, Sevoflurane and Halothane
Prediction trend and waveform	
	The system displays 8 waveforms: 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≠0: - 20 % to 30 % of the measured EtAA, or - 5 % to 7.5 % of the vaporizer maximum setting, whichever is greater
	EtO_2 : - 10 % to 15 % of the measured EtO_2, or volume fraction of - 5 % to 7.5 %, whichever is greater

Electrical Specifications

Current Leakage

100 ~ 240V	< 500 μA

Power and Battery Backup

Power input	220-240 V, 50/60 Hz, 6A
	100-120 V, 50/60 Hz, 7A
	100-240 V, 50/60 Hz, 7A
Auxiliary electrical outlets	
	Up to 4 outlets (3A for each, total 5A)
Battery backup	150 minutes in case of two batteries (powered by new fully-charged batteries with 25°C ambient temperature)
Battery type	Build-in Li-ion battery, 9000 mAh (two batteries)
Safety feature	In case of electricity and battery failure, manual ventilation, gas delivery and agent delivery are possible

Pneumatic Specifications

ACGO (Auxiliary Common Gas Outlet, Integrated)

Connector	ISO 22 mm OD and 15 mm ID

Pipeline Supply

Gas type	O_2, N_2O and Air
Pipeline input range	280 to 600 kPa
Pipeline connections	DISS or NIST

Pipeline Supply Pressure Gauges

Display type	Electronic or Mechanical
Ranges	0 to 1000kPa
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
N_2O Input Range	4.2 to 6 MPa
Air Input Range	6.9 to 20 MPa
Cylinder Connections	Pin-Index Safety System (PISS)
Yoke Configuration	O_2, N_2O, Air

Cylinder Supply Pressure Gauges

Display type	Electronic or Mechanical
Air Range	0 to 25 MPa
O_2 Range	0 to 25 MPa
N_2O Range	0 to 10 MPa
Accuracy	± (4% of the full scale reading+8% of the actual reading)

O_2 Controls

Method	N_2O shut off with loss of O_2 pressure
Supply failure alarm	≤ 220.6 kPa ± 34.2kPa
O_2 Flush	25 ~ 75 L/min

Auxiliary O_2 Flowmeter

Range	0 ~ 15 L/min
Indicator	Flow tube

High Flow Nasal Cannula Oxygen (HFNC)

Range	0 ~ 60 L/min
Indicator	Flow tube

Electronic Flow control system (Electronic Mixer)

Direct Flow Control Mode

O_2 flow range	0 to 15 L/min
Air flow range	0 to 15 L/min
N_2O 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_2O) flow accuracy	
	± 50 ml/min or ±5% of setting value, whichever is greater

Total Flow Control Mode

Total flow range	0.2 to 18 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) or 26% to 100% (The balance gas is N_2O)
Accuracy	± 5% V/V for flows < 1 L/min or 5% setting for flows ≥ 1 L/min

Optimizer
Only available when AG or CO_2 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)

Total flow meter

Control Range (O2)	1 +/- 0.25 to 10 L/min
Indicator	Flow tube
Indicator accuracy	± 10% of the indicated value for flows (between 10% and 100% of full scale with oxygen)

Environmental Specifications

Operating

Temperature	10 ~ 40°C
Relative humidity	15% ~ 95% (noncondensing)
Barometric (Kpa)	70 ~ 106 kPa

Storage

Temperature	-20 ~ 60°C for main unit, -20 ~ 50°C for O_2 sensor
Relative humidity	10% ~ 95% (noncondensing)
Barometric	50 ~ 106 kPa

Electromagnetic Compatibility

Immunity	Complies with all requirements of IEC 60601-1-2
Emissions	Complies with all requirements of IEC 60601-1-2

Breathing System Specification

Breathing system volume (Pre-pak)

Automatic ventilation	2850 ml
Manual ventilation	1800 ml

Breathing system volume (Non Pre-pak)

Automatic ventilation	2600 ml
Manual ventilation	1800 ml

System Components
Carbon dioxide absorbent canister
Absorbent capacity: 1500 mL
Integrated expiratory limb water trap
Capacity: 6 mL

Breathing Circuit Parameters

System leakage	≤ 60 mL/min at 3 kPa
Compliance	≤4 mL/100Pa (Manual mode) Automatically compensates for compression losses within the breathing circuit in mechanical mode
Expiration resistance	< 6.0 cm H_2O @60 L/min
Inspiration resistance	< 6.0 cm H_2O @60 L/min

System Pressure Gauge

Range	-20 ~ 100 cmH_2O
Accuracy	± (2% of the full scale reading + 4% of the actual reading)

Ports and 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

Integrated Adjustable Pressure Limiting (APL) Valve

Range	SP, 5 ~ 70 cmH_2O
Tactile knob indication at above 30 cmH_2O	
Accuracy	± 3 cmH_2O or ± 15% of the setting value, which is greater, but is not more than + 10 cmH_2O

Anesthetic Gas Scavenging System (AGSS)

Size (H x W x D)	430 x 132 x 114 mm
Type of disposal system	Active: High-flow or Low-flow Passive
Applicable standard	ISO 80601-2-13
Pump rate	75 ~ 105 L/min (High-flow) 25 ~ 50 L/min (Low-flow)

Pressure relief device: Pressure compensation opening to the air
State indication of the disposal system: The float falls below the "MIN" mark on the sight glass when the disposal system does not work or the pump rate is lower than 25 L/min (Low-flow) or 75 L/min (high-flow).
Connector of the disposal system: ISO 9170-2

Materials
All materials in contact with exhaled patient gases are autoclavable, except flow sensors (being not capable of being autoclaved), O_2 sensor, and mechanical pressure gauge.
All materials in contact with patient gas are latex free.

Suction Device

Venturi Suction Regulator

Gas source	Air, from system gas source
Minimum flow	20 L/min
Maximum vacuum	≥72 kPa at supply gas pressure of 280 kPa; ≥73 kPa at supply gas pressure of 600 kPa

Continuous Suction Regulator

Supply	Negative Pressure Suction
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
Minimum flow	20 L/min

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

www.mindray.com

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