8 Technical specifications

Unless otherwise specified, the data refer to a temperature of 25 °C.

8.1 MAGLIFE Serenity

Dimensions	442 x 452 x 310 mm (w x h x d)
Weight	approx. 23 kg
Protection case	IP20
Mains power	
Protection class	Class I
Rated voltage range	115 - 230 VAC, 50/60 Hz version for Japan: 100 VAC, 50/60 Hz
Power consumption	approx. 55 VA
Instrument fuses	315 mA (T) 250 VAC (230 VAC), 500 mA (T) 250 VAC (115 VAC) version for Japan: 630 mA (T) 250 VAC (100 VAC)
Environmental conditions	
For operation	10 ... 30 °C (only for use in air-conditioned rooms with a regulated temperature of + 20 °C ± 5 °C) atmospheric pressure 700 to 1060 hPa
For storage and transport	-10 ... 50 °C; relative humidity at 0...95% (noncondensing) atmospheric pressure 500 to 1060 hPa
Battery power	
Battery 1	sealed lead battery, 12 V, 17 Ah
Operating time	6 hours
Battery charging	automatic when monitor connected to power line and turned off
Recharging indicator	indicator
Low battery indication	screen message
Recharging time	10 hours
Battery 2	sealed lead battery, 12 V, 4 Ah
Operating time	1h30
Battery charging	automatic when monitor connected to power line
Recharging indicator	indicator
Low battery indication	screen message
Recharging time	10 hours (monitor on), 5 hours (monitor off)

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EMC	• **MAGLIFE Serenity** complies with the electromagnetic immunity requirements of standard IEC 60601-1-2 "Electromagnetic Compatibility - Medical Electrical Equipment". • The emitted radio interference is within the limits of the standard CISPR 11 for class B equipment. • **MAGLIFE Serenity** can be exposed to the following levels of interference without losing its functionality: – Static discharges up to 8 kV. – Radio frequencies up to 10 V/m (from 80 to 2500 MHz, 5 Hz modulated).
Compliance	• **MAGLIFE Serenity** bears the CE 0459 (Notified body LNE/G-MED), mark indicating its compliance with the provisions of the Council Directive 93/42/EEC (modified by the Council Directive 2007/47/EEC) regarding medical devices and fulfills the essential requirements of Annex I of this directive. • **MAGLIFE Serenity** is a class IIb device.
Protection Class	class I according to IEC 60601-1
Signal imputs	Type CF, defibrillation-proof
Protection Against Ingress of Liquids	Enclosed device without additional protection against the ingress of liquids
Degree of protection	MAGLIFE Serenity/MAGSCREEN Serenity are not suitable for use in the presence of flammable mixtures of anesthetic agents with air, oxygen.
Operational mode	continuous operation

The SCHILLER quality management system complies in full with the international standards ISO 9001 and ISO 13485.

8.2 MAGSCREEN Serenity

Dimensions	450 x 398 x 260 mm (w x h x d)
Weight	approx. 12 kg
Protection case	IP20
Environmental conditions	
For operation	10 ... 40 °C (only for use in air-conditioned rooms with a regulated temperature of +20 °C ± 5 °C) atmospheric pressure 700 to 1060 hPa
For storage and transport	-10 ... 50 °C; relative humidity at 0...95% (noncondensing) atmospheric pressure 500 to 1060 hPa
Power	
Protection class	Class I
Rated voltage range	100 VAC - 240 VAC, 50/60 Hz
Power consumption	approx. 40 VA
Instrument fuses	800 mA (T) 250 VAC

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8.3 Wi-Fi connection box

Dimensions	291 x 211 x 64 mm (w x h x d)
Weight	approx. 2.1 kg
Protection case	IP20
Environmental conditions	
For operation	10 ... 30 °C (only for use in air-conditioned rooms with a regulated temperature of +20 °C ± 5 °C) atmospheric pressure 700 to 1060 hPa
For storage and transport	-10 ... 50 °C; relative humidity at 0...95% (noncondensing) atmospheric pressure 500 to 1060 hPa
Power	
Protection class	Class I
Rated voltage range	115 - 230 VAC, 50/60 Hz version for Japan: 100 VAC, 50/60 Hz
Power consumption	approx. 7 VA
Instrument fuses	160 mA (T) 250 VAC (230 VAC), 315 mA (T) 250 VAC (115 VAC) version for Japan: 315 mA (T) 250 VAC (100 VAC)

8.4 Wi-Fi specification

Modules	WLM54AG
FCC ID **IC ID**	TKC-05-WLM54AG (6B) 7849A-WLM54AG
Transmission standards	IEEE 802.11 a, b, g
Encryption	WEP64/128
Max. transmitting power	23 dBm
Frequency range	Dual-band 2.4 GHz and 5 GHz

8.5 LCD Screens

Screen	type: VGA, TFT technology size: 12.1 inches 256 colours 800 x 600 pixels
Sweep speed	25 mm/s and 50 mm/s
Deflection direction	from left to right
Waveform freeze	with pushbutton
Backlighting	cold cathode fluorescent lamp

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8.6 Alarms

Physiological and technical alarms	visual and audible signalling alarms can be paused for 2 minutes or permanently disabled; if permanently disabled, the monitor beeps every 2 minutes
Priorities	physiological alarm (if several modules send alarms at the same time) technical alarm (if the same module sends several alarms)
Frequency of the audio alarm signal	1000 Hz and 2000 Hz
Alarm delay	4 s (8 s at power-up)

8.6.1 Alarm limit ranges

Parameter	Value	Unit 1	Unit 2	Unit 3
ECG	Heart rate (b/min)	5-250		
SpO_2	SpO_2 Value (%)	50-99		
	Puls rate (P/min)	30-250		
NIBP Adult/Child		mmHg	kPa	
	Systolic	30-255		
	Diastolic	15-220		
	MAP	20-235		
NIBP Neonatal	Systolic	30-135		
	Diastolic	15-110		
	MAP	20-125		
IBP		mmHg	kPa	
	Systolic	5-300		
	Diastolic	5-300		
	MAP	5-300		
Temperature		°C	°F	
		25-45		
Capno		mmHg	kPa	%
	$EtCO_2$	5-100		
	$insCO_2$	0-50		
	Respiration rate (resp/min)	5-50 / 5-199		
	Apnéa (s)	3-30		
N_2O (%)	$insN_2O$	1-75		

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Parameter	Value	Unit 1	Unit 2	Unit 3
O_2 (%)	etO_2	13-100		
	$insO_2$	12-100		
Agent (%)	Halothan	0-10		
	Isofluran	0-10		
	Enfluran	0-10		
	Sevofluran	0-10		
	Desfluran	0-10		
Magnetic Field	X, Y, Z, Module	mT		
		1-40		

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8.7 ECG signal

Signal input	type CF (defibrillation-proof) signal acquisition by ECG sensor with optical wave guide leads 1, 2, 3 common mode rejection ratio > 80 dB electrode problem detection patient leakage current < 10 µA
Recovery time after defibrillation	3.5 s
Band pass	0.5 Hz to 40 Hz (-3 dB) w/o. filter; 0.5 Hz to 22 Hz (-3 dB) with filter
Heart rate measuring range	30 to 250 bpm ± 2 bpm
Accuracy of the heart rate readout	5 bpm, if T-wave < 0.8 x R-wave
Response time	2.5 s between 40 and 80 bpm in an ascending or descending phase
Sweep speed	25 mm/s and 50 mm/s ± 5%
Calibration	1-mV pulse (on screen and printout)
Sensitivity	0.25 - 0.5 - 1 - 2 cm/mV ± 10%
QRS indication	by audible and visual signals
Suppression of large T-waves	max. amplitude of T-wave according to IEC 60601-2-27 section 50.102.17: 1.2 mV
HR averaging method	Time between the last two QRS. Updating rate of the display 0.5 s
Response time HR measurement	Change from 80 to 120 beats per minute: 3 s Change from 80 to 40 beats per minute: 5 s
Reaction to an irregular rhythm	• A1: 81/min or 40/min • A2: 61/min or 30/m • A3: 122/min • A4: 120/min (according to IEC specifications 60601-2-27, 6.8.2.bb)
Duration until alarm is triggered in the case of tachycardia	• B1: 9 s • B2: 7 s
half amplitude B1&2	• B1/2: 10 s • B2/2: 10 s
twice amplitude B1&B2	• B1x2: 7 s • B2x2: 5 s (according to IEC specifications 60601-2-27, 6.8.2.bb)

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8.7.1 Pacemaker pulse rejection

Pacemaker pulses are not rejected by the MAGLIFE Serenity.

8.8 Pulse

Signal input	connection for SpO_2 sensor with optical wave guide, type CF applied part (defibrillation-proof)
Measuring method	spectrophotometric
Sensitivity	automatic gain adjustment
Averaging	over 8 s or 16 s
Measuring range	30 to 250 bpm
Error	± 5 bpm

8.9 SpO_2

Signal input	connection for SpO_2 sensor with optical wave guide, type CF applied part (defibrillation-proof)
Measuring method	spectrophotometric
Sensitivity	automatic gain adjustment
Averaging	over 8 or 16 beats
Measuring range	0 - 99 %
Error	± 1 % between 90 and 100 % + 3 % between 81 and 89 % + 5 % between 55 and 80 %

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8.10 CO_2

Signal input	connection for sample line, type CF applied part (defibrillation-proof)
Measuring method	spectrophotometric
Sensitivity	3 gain factors: 50, 75, 100 mmHg
Measuring range	$EtCO_2$: 0 to 270 mmHg (0 to 12.6 kPa) $MinCO_2$: 0 to 270 mmHg (0 to 12.6 kPa) respiration rate: 2 to 100 resps/min
Error	$EtCO_2$: ± 0.5 % abs. max. $MinCO_2$: ± 0.5 % abs. max. respiration rate: ± 1 resp/min

8.11 N_2O

Signal input	connection for sample line, type CF applied part (defibrillation-proof)
Measuring method	spectrophotometric
Measuring range	0 to 950 mmHg
Error	± 3 % abs. max.

8.12 Anesthetic agents

Signal input	connection for sample line, type CF applied part (defibrillation-proof)
Measuring method	spectrophotometric
Choice of anesthetic agents	isoflurane halothane enflurane sevoflurane desflurane
Measuring range	0... 30 %
Error	isoflurane: ± 0.2 % abs. max. halothane: ± 0.2 % abs. max. enflurane: ± 0.2 % abs. max. sevoflurane: ± 0.4 % abs. max. desflurane: ± 1 % abs. max.

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Resolution	0.1 %
Rise times ($t_{10...90\%}$)@ 120 ml/min.)	
CO_2	60 ms
N_2O	300 ms
O_2	300 ms
Hal, Iso, Sev, Des	300 ms
Total response time	<4 s
Primary agent ID threshold	0.15% (0.4% during ISO accuracy mode)
Secondary agent ID threshold	0.3% (0.5% during ISO accuracy mode) or 5% rel (10% rel for Isoflurane) of primary agent if primary agent >10%

Interfering gas and vapour effects

Gas or vapour	Gas level (% volume fraction)	Interference (% ABS)	
Nitrous oxide	60		0
Halothane	4	CO_2	0
		N_2O	0.1
		O_2	0.1
		2nd agent	0.2
Enflurane	5	CO_2	0
		N_2O	0.1
		O_2	0.1
		2nd agent	0.2
Isoflurane	5	CO_2	0
		N_2O	0.1
		O_2	0.1
		2nd agent	0.2 (typical
Sevoflurane	5	CO_2	0
		N_2O	0.1
		O_2	0.1
		2nd agent	0.2 (typical
Desflurane	15	CO_2	0
		N_2O	0.1
		O_2	0.1
		2nd agent	0.2 (typical
Ethanol	<1	CO_2	0
		N_2O	0.1
		Agent	0.0
Acetone	<1	CO_2	0
		N_2O	0.1
		O_2	0.1
Methane	<1	CO_2	0
		N_2O	0.1
		O_2	0.1

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8.13 O_2

Measuring method	with galvanic cell
Signal input	connection for sample line, type CF applied part (defibrillation-proof)
Measuring range	0... 100 %
Error	± 4 % abs. max.
Resolution	1 %

8.14 Non-invasive Blood Pressure

Measuring method	oscillometric
Measuring range	Adults/children: 10 to 290 mmHg Neonates: 5 to 145 mmHg
Signal input	type CF applied part (defibrillation-proof)
Recovery time after defibrillation	5 s
Error	± 3 mmHg
Measuring range	Adults/children: systolic pressure: 30 to 255 mmHg diastolic pressure: 15 to 220 mmHg mean pressure: 20 to 235 mmHg Neonates: systolic pressure: 30 to 135 mmHg diastolic pressure: 15 to 110 mmHg mean pressure: 20 to 125 mmHg In the adult mode, the blood pressure measured with this device corresponds to the value determined by a trained user with stethoscope and cuff. In the neonatal mode, the blood pressure measured with this device corresponds to the value determined with an invasive blood pressure measurement device.

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8.15 Invasive Blood Pressure

Signal input	type CF applied part (defibrillation-proof)
Measuring range	0 to 300 mmHg
Zero	automatic
Error	4 mmHg
Resolution	1 mmHg
Adjustment range	30 - 60 - 150 - 300 mmHg and automatic scale
Band pass (-3 dB)	0 to 10 Hz (w/o. filter)

8.16 Temperature

Signal input	connection for fibre optic probe, type CF applied part (defibrillation-proof)
Sensor application	on the skin surface
Measuring method	optical interferometry
Error	± 0.3 °C
Measuring range	20 to 45 °C
Resolution	0.1 °C

8.17 Printer

Type	High resolution thermo-printer
Paper	Thermo-reactive, Z-folded, 79 mm width, length approx. 15 m
Resolution	8 dots/mm (amplitude-axis), 40 dots/mm (time-axis) at 25 mm/s,
Print speed	25 mm/s
Start	single printings initiated by key press; automatic printings upon alarm

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8.18 Electromagnetic Interferences

The **MAGLIFE Serenity** is intended to be used in the electromagnetic environments listed in the following tables. The user of the **MAGLIFE Serenity** has to ensure that the device is operated in an adequate environment.

8.18.1 Electromagnetic emissions

Emission measurement	Compliance with the regulations	Electromagnetic environment - explanations
RF emissions CISPR 11	Group 1	**MAGLIFE Serenity** only uses RF energy for internal functions. Therefore, RF emissions are very low and interferences with electronic devices nearby are unlikely.
RF emissions CISPR 11	Class B	**MAGLIFE Serenity** is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonics emissions IEC 61000-3-2	Class B	
Voltage fluctuations/flicker IEC 61000-3-3	Compliants	

8.18.2 Electromagnetic immunity

Immunity test	IEC 60601 test level	Conformity level	Electromagnetic environment - explanations
Electrostatic discharge IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be made of wood, concrete or ceramic tiles. If floors are covered with synthetic material, relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial and/or hospital environment.
Surge IEC 61000-4-5	± 1 kV line to line ± 2 kV line to ground	± 1 kV line to line ± 2 kV line to ground	Mains power quality should be that of a typical commercial and/or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (> 95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 s	< 5 % U_T (> 95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the **MAGLIFE Serenity** is reliant on permanent operation even in the case of a power failure, it is suggested connecting the **MAGLIFE Serenity** to an uninterruptible power supply or use it with a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	IEC 60601-1 conformity	Power frequency magnetic fields should be that of a typical commercial and/or hospital environment.

Note: U_T indicates the AC voltage of the mains before the test level.

Immunity test	IEC 60601 test level	Conformity level	Electromagnetic environment - explanations
			Recommended minimum distances Portable and mobile RF telecommunication devices must keep the recommended minimum distance from the **MAGLIFE Serenity** and all its components, incl. cables; the recommended minimum distance is calculated based on the transmitter's frequency.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Veff between 150 kHz and 80 MHz outside of the ISM frequency bands[a] 10 Veff between 150 kHz and 80 MHz within the ISM frequency bands[a]	$d = \frac{3,5}{3} \times \sqrt{P}$ $d = \frac{12}{10} \times \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	10 V/m 80 MHz to 2.5 GHz	$d = \frac{3,5}{10} \times \sqrt{P}$ between 80 MHz and 800 MHz $d = \frac{7}{10} \times \sqrt{P}$ between 800 MHz and 2.5 GHz where P is the maximum transmitting power of the transmitter in Watt (W) according to manufacturer data, and d the recommended minimum distance in metres (m)[b]. The field strength of stationary RF transmitters (according to an on-location measurement [c]) must not exceed the conformity level for each frequency range [d]. When operating the device near devices bearing the symbol "ionising radiation", interferences can occur. 

Note 1 For 80 MHz to 800 MHz, the higher frequency range applies.
Note 2 These guidelines might not always be applicable. Electromagnetic propagation is influenced by absorption and reflection on structures, objects and people.

a. The ISM frequency bands (ISM = industrial, scientific, medical) between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

b. The conformity levels within the ISM frequency bands between 150 kHz and 80 MHz and between 80 MHz and 2.5 GHz serve to minimise the probability of interferences caused by mobile/portable communication equipment that accidentally happens to be in the patient environment. The formula for the calculation of the recommended distance has been adapted by the factor 10/3 for transmitters in this frequency range.

c. The field strength of stationary transmitters, e.g. base stations for radio telephones (mobile or cordless) and portable radio equipment, amateur radios, AM and FM radios and TV signals cannot be predicted accurately in a theoretical way. In order to analyse electromagnetic environments caused by stationary RF transmitters, an electromagnetic analysis on site should be considered. If the measured field strength exceeds the RF conformity level, it needs to be checked whether the **MAGLIFE Serenity** can be used in this environment. If an abnormal behaviour is detected, additional measures need to be taken, e.g. reorientation or change of location of the **MAGLIFE Serenity**.

d. For the frequency range between 150 kHz and 80 MHz, the field strength must be lower than 3 V/m.

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8.18.3 Recommended minimum distances

The **MAGLIFE Serenity** is intended to be used in electromagnetic environments in which it is possible to control radiated RF interferences. The user of the **MAGLIFE Serenity** can prevent electromagnetic interferences by always keeping a minimum distance between portable/mobile RF communication devices (transmitters) and the **MAGLIFE Serenity**. The recommended minimum distances are listed in the following table according to the transmitters' max. transmitting power.

Max. transmitting power of the transmitter (W)	Distances according to the transmitter's frequency (m)		
	150 kHz and 80 MHz $d = \frac{3,5}{3} \times \sqrt{P}$	80 MHz and 800 MHz $d = \frac{3,5}{10} \times \sqrt{P}$	800 MHz to 2.5 GHz $d = \frac{7}{10} \times \sqrt{P}$
0.01	0.12	0.04	0.07
0.1	0.37	0.11	0.22
1	1.17	0.35	0.7
10	3.69	1.11	2.21
100	11.67	3.5	7

For transmitters rated at maximum power not listed in the above table, the recommended separation distance d in metres can be estimated using a the equation applicable to the frequency on the transmitter, where P is the max. output power of the transmitter in Watts (W) according to manufacturer data.

Note 1 At 80 MHz and 800 MHz, the separation distance for the higher frequnecy range applies
Note 2 These guidelines may not apply in all situation. Electromagnetic propagation is affected by absorption and reflection from structure, object and people