PHILIPS

Technical Data Sheet

Expression Model **MR400**

MRI Patient Monitoring System

The Expression Model MR400 MRI Patient Monitoring System is designed to assist clinicians in monitoring patient vital signs in the dynamic magnetic resonance environment. The Expression Model MR400 MRI Patient Monitoring System combines wireless communication, radio frequency shielding and digital signal processing to address the challenges associated with patient monitoring in the MR environment.

The Expression Model MR400 MRI Patient Monitoring System consists of these primary components:

- Traditional Roll-Around Cart
- Wireless ECG (wECG) module
- Wireless SpO_2 ($wSpO_2$) module

Features and Benefits

- Integral color, 15” LED widescreen display for high resolution patient information
- Intuitive touchscreen graphical user interface
- Colored waves and large numeric displays
- Bedside-quality “SINC” parameters
- Exclusive, advanced ECG solution for MRI
- 8-hour battery life and user-replaceable batteries for extended run time
- Simultaneous display of up to 13 parameters, and 6 waveforms and associated values
- Multi-priority visual and audible alarm signals, unique “alarm flag” messages, and pulse tones
- Gating, both digital pulse and analog waveform

Optional Components

- Expression Information Portal (IP5)
- Wireless remote printing to IP5

Ordering Information

Standard Features, 866185

A01: Standard Accessories

Options

F01: Basic (NBP, ECG, SpO_2, CO_2, RR)
F02: Basic + IBP (x2)
F03: Basic + Temp
F04: Basic + AA, O_2
F05: Basic + AA, O_2, IBP (x2)
F06: Basic + AA, O_2 , Temp
F07: Basic + AA, O_2, IBP (x2), Temp

System Parameters

The Expression Model MR400 MRI Patient Monitoring System can include the following vital sign parameters:

- Electrocardiogram (ECG), dual channel
- Blood oxygen saturation/pulse oximetry (SpO_2)
- Invasive blood pressure (IBP)
- Non-invasive blood pressure (NIBP)
- End-tidal and inspired CO_2
- Respiration from CO_2 or bellows
- Anesthetic Agents, including end-tidal and inspired N_2O, inspired O_2, and Total MAC
- Temperature

The system can include the ability to display these parameters:

- Alarms: High and low selectable limits for each patient parameter
- ECG: Waveform scale, dual channels displayed
- Heart rate: Factory-default derived from ECG; also from pulse oximetry or IBP
- Pulse oximeter: Pulse rate, pulse waveform, and percent saturation
- CO_2: End-tidal and inspired
- IBP (two channels, P1 and P2): Systolic, mean, and diastolic pressures
- NIBP: Systolic, mean, and diastolic pressures
- Anesthetic Agents, including end-tidal and inspired N_2O, and inspired O_2
- Bellows respiration: Rate derived from pneumatic chest bellows
- Temperature
- Trends: Heart rate, respiration rate, IBP (systolic, diastolic, mean), NIBP (systolic, diastolic, mean), CO_2, O_2, N_2O, SpO_2, agents, and temperature
- Respiration: Rate derived from CO_2
- Time: Battery-backed quartz clock

Main Component

Display Panel

Type: Liquid Crystal Display (LCD), touch screen, color
Screen size: 39.5 cm (15.6 inches) diagonal
Drive type: a-Si TFT active matrix
Pixels: 1366 (H) by 768 (V) pixels, color
Area: 344.2 (H) by 193.5 (V) mm
Dot pitch: 0.084 (H) by 0.252 (V) mm
Pixel pitch: 0.252 (H) by 0.252 (V) mm
Contrast ratio: 500:1 (typical)
Backlight: LED
Polarizer surface: Anti-glare
Tilt: Adjustable, 5° to 35°
Sweep speeds for ECG, SpO_2, and IBP: 25 mm/second gives 9.1 seconds of display time, while 50 mm/second gives 4.6 seconds. Sweep speeds for respiration: 3.125, 6.25, 12.5 or 25 mm/second are provided.
Waveform display mode: Fixed trace, moving erase bar
Waveform display length: ≥ 228 mm
Waveform display height: ECG (single trace): ≥ 40 mm; ECG (dual trace): ≥ 20 mm; All other waveforms: ≥ 25 mm
Speaker: Audio
Control of monitored parameters provided by: Power switch; Touchscreen

User Interface

Four groups of data are displayed: Informational, Vital sign traces, Vital sign numeric values, System status

Application Features

Trends

- Data at 1-minute intervals, up to 12 hours of data
- Automatically can store the parameter trend information for heart rate, IBP, NIBP, SpO_2, CO_2, N_2O, O_2, agents, respiration, and temperature

- Trend arrows graphically indicate an increasing, decreasing or stable parameter
- Graphical trends (with the IP5 option)

Alarms

Severity: High, medium, and low
Visual indicators: Alarm light, flashing numeric values, alarm flags, icons
Audible alarms: User-configurable for volume, tone, and silence
Limits: Configurable; 1-Touch Alarms allow limits to be quickly adjusted

Device Connections

Input/output ports permit the connection of external equipment: USB port (system update use only); ECG and peripheral gating output port

Specifications

Safety Standards

- Conforms to ANSI/AAMI ES 60601-1: 2012. Certified to CAN/CSA C22.2 No. 60601-1-08; IEC 60601-1-2
- Conforms to 93/42/EEC as amended by 2007/47/EEC, *Medical Device Directive*
- Defibrillator protection up to 5 KV

Physical Specifications

Cart

Size: 127.3 x 47.5 x 55.9 cm (50.1 x 18.7 x 22 in.)
Weight: 46.9 kg (103.3 Lbs)

Wireless ECG module

Size: 18.2 x 6.7 x 3.1 cm (7.17 x 2.65 x 1.24 in.)
Weight: 340 g (12 oz.)

Wireless SpO2 module

Size: 13.0 x 6.5 x 3.1 cm (5.13 x 2.55 x 1.24 in.)
Weight: 204 g (7.2 oz.)

Electrical Specifications

Power Requirements

Operating voltage range: 100 to 240 VAC
Frequency range: 50 to 60 Hz
Current: 1.4 A @ 100 VAC / 0.7 A @ 240 VAC
Maximum power consumption: ≤ 65 Watts

Battery Type

Cart: Lithium-Ion
Module: Lithium polymer

Battery Operation Time - Cart

All displays, alarms, and monitoring functions: continuously for 8 hours
ECG & SpO_2: 8 hours
CO_2 (with or without AGENT)**:** continuously for 6 hours
Invasive Pressures: continuously for 6 hours
AGENT analysis: continuously for 6 hours
Temperature: continuously for 6 hours
NIBP: readings every 5 minutes for 6 hours

Battery Operation Time - Module

Duration: Approximately 8 hours

Battery Capacity

Cart: 75 Wh/battery (300 Wh capacity with 4 batteries installed)
Module: 3.1 Wh

Environmental Specifications

Operating temperature range: 10 to 35°C (50 to 95°F)

Relative humidity range

Cart, bellows, SpO_2 accessories, LoFlo accessories (optional), gating cables (optional), and IP5 (optional): 15 to 80 %, non-condensing

Wireless modules, ECG cables, and FlexTEMP II sensor: 5 to 80 %, non-condensing

IBP transducer kits and cable (optional): 15 to 85 %, non-condensing

Module batteries: 15 to 90 %, non-condensing

Storage and transport temperature range

Cart: -20 to 50°C (-4 to 122°F)
Cart batteries: 0 to 40°C (32 to 104°F)
Wireless modules, and all other accessories not specified below: -20 to 60°C (-4 to 140°F)
Quadtrodes: 10 to 32°C (50 to 90°F)
Optional Transducer kits/cable: -15 to 60°C (5 to 140°F)
O_2 sensor (AGENT option), storage: 5 to 25 °C (41 to 77 °F); **transport:** -40 to 50 °C (-40 to 122 °F)
ECG skin prep gel: Follow instructions on tube.
NOTE: When storing or transporting in temperatures beyond the ranges specified above, remove the designated component and store or move it appropriately.
Operating pressure range: Up to 3,000 m (9,842 feet) above sea level (708 mbar or 531 mmHg)
Storage and transport pressure range: 708 to 1020 mbar

MRI Rating

MR Conditional: 1.5 and 3.0 Tesla, 5000 gauss, at RF power levels not exceeding 4W/kg SAR and 7.2 µT $B1_{rms}$ in all orientations

Measurement Specifications

Electrocardiogram Channel (ECG)

ECG Amplifier: Protected against defibrillator and electro-surgery potentials
Standard lead configurations: I, II, III, AVR, AVL, AVF
Lead Fail: Passive, sensing signal imbalance
ECG input impedance: > 2.5MΩ (according to IEC 60601-2-27, 50.102.3)

Electrode contact impedance: ≤ 20K ohms @ 10 Hz

Heart Rate
Range: 30 to 250 bpm (adult); 30 to 300 bpm (pediatric and neonate)
Resolution: 1 bpm
Accuracy: ± 1 % or ± 1 bpm, whichever is greater

Cardiotach
Sensitivity (Monitor filter): > 200 µV (Adult ECG mode); > 100 µV (Neonate/Pediatric ECG mode)
Bandwidth: Monitor (0.5 to 40 Hz)
QRS Duration: 70 to 120 ms (adult); 40 to 120 ms (Neonate/Pediatric)
Baseline Offset: Automatically removed
Tall T-wave rejection capability for heart rate indication: 2 mV with a 1 mV QRS amplitude
Leads-off sensing: Detection by DC current waveform of < 100 nA

Alarm Limits

Lower*	Upper*
30 to 250 bpm	60 to 250 bpm

* Off is an option for each alarm limit

Test/Calibrations
Square wave test signal: 60 bpm ± 1 bpm, 1 mV ± 10 %

Pulse Oximeter

(Pitch of pulse tone is modulated by saturation value.)
Saturation range: 1 to 100 %
Saturation value resolution: 1 %
Saturation accuracy: ± 3 % at 70 to 100 %
Pulse accuracy: ± 2 % or ± 1 bpm, whichever is greater
Pulse rate range: 30 to 250 bpm
Pulse rate resolution: 1 bpm
Perfusion Index: Decimal Number
Data update period: 5, 10, or 15 seconds (according to the SpO_2 Averaging Time setting)
Data update period during alarm: 9, 14, or 19 seconds, maximum (4 seconds plus the SpO_2 Averaging Time setting of 5, 10, or 15 seconds)
Wavelength range: 500 to 1000 nm (Information about wavelength range can be especially useful to clinicians)
Emitted light energy: < 15 mW
Pulse oximeter calibration range: 70 to 100 %

Alarm Limits

	Lower*	Upper*
SpO_2	50 to 100 %	70 to 100 %
When "HR" is derived from SpO_2	30 to 250 bpm	60 to 250 bpm

* Off is an option for each alarm limit

CO_2 (Optional LoFlo)

(Side stream non-dispersive infrared absorption technique, including multiple water trap filtration system and microprocessor control of sample handling and calibration.)

Method for determining end tidal CO_2 measurement: Measures peak of the expired CO_2 waveform every 20 seconds.
Output: CO_2 waveform, $EtCO_2$ and $FiCO_2$ numeric values, and respiration rate
Initialization time: Waveform displayed in less than 20 seconds, at an ambient temperature of 25°C (77°F); full specifications attained within 2 minutes
Zero calibration interval: Automatic or user requested
CO_2 unit of measure: Millimeters of mercury (mmHg) or kilopascals* (kPa)

**For kilopascals (kPa), allow ± 1 least significant digit to accommodate round-off error for calculated values.*

CO_2 resolution: 1 mmHg (0.1 kPa)
Flow rate: 50 mL per minute ± 10 mL per minute
Data sample rate: 100 Hz
$EtCO_2$ measurement range (in which the accuracy specification is met: 0 to 76 mmHg (0 to 10.1 kPa) for respiration rates ranging from 4 to 60 breaths per minute, inclusive
Inspired CO_2 ($FiCO_2$) measurement range: 0 to 50 mmHg (0 to 6.7 kPa) (method: lowest reading of the CO_2 waveform in the previous 20 seconds)
CO_2 accuracy: ± 4 mmHg (± 0.5 kPa) or ± 12 %, whichever is greater
Short term drift: Not to exceed 0.8 mmHg (0.1 kPa) over a 4-hour period
Long term drift: Accuracy specification maintained over a 120-hour period
Respiration accuracy: ± 1 breath or ± 3 %, whichever is greater
Respiration resolution: 1 rpm
Respiration rate range (in which the respiration accuracy specification is met: 4 to 100 rpm, inclusive
Accessory usage: Functional without changing accessories for a minimum of 6 hours
Response and rise times:
(As measured from the patient gas input of the complete pneumatic circuit, including tubing, from 10 to 90 percent of the measured CO_2 levels)

	System Response (sec)	Rise Time (sec)
Airway Adaptor	10.89	0.94
Cannula	12.44	1.12
Divided Cannula	16.17	2.01

Compensations

(Automatic CO_2 ambient pressure compensation 523 to 760 mmHg [69.7 to 101.3 kPa]; for expired O_2 balance gas (N_2, N_2O, O, He) and anesthetic agents; Uses gas compensation information to correct the raw carbon dioxide value)
Anesthetic agent effects (MAC levels)
Uncompensated Sensitivity: Accuracy maintained for halogenated anesthetic agents present at accepted Minimum Alveolar Concentration clinical levels
Compensated Sensitivity: Testing at agent levels defined by accepted regulatory standards (80601-2-55:2011)
Cross-sensitivity compensation error:
(Additional worst case error when compensation for O_2, N_2O, anesthetic agents, or helium is correctly selected for the actual fractional gas constituents present)
0 to 40 mmHg: ± 1 mmHg (0 to 5.3 kPa: ± 0.1 kPa)
41 to 70 mmHg: ± 2.5 mmHg (5.5 to 9.3 kPa: ± 0.3 kPa)
71 to 100 mmHg: ± 4 mmHg (9.5 to 13.3 kPa: ± 0.5 kPa)
101 to 150 mmHg: ± 5 mmHg (13.5 to 20 kPa: ± 0.6 kPa)
Quantitative effects of gas sample humidity or condensate:**
0 to 40 mmHg: ± 2 mmHg (0 to 5.3 kPa: ± 0.2 kPa)
41 to 70 mmHg: ± 5 % (5.5 to 9.3 kPa: ± 5 %)
71 to 100 mmHg: ± 8 % (9.5 to 13.3 kPa: ± 8 %)

101 to 150 mmHg: ± 10 % (13.5 to 20 kPa: ± 10 %)

***With appropriate compensations applied*

Alarm Limits

	Lower*	Upper*
$EtCO_2$	5 to 60 mmHg; 0.6 to 8.0 kPa	5 to 76 mmHg; 0.7 to 10.1 kPa
$FiCO_2$	No low alarm limit	0 to 20 mmHg; 0 to 2.7 kPa
Respiration	4 to 40 rpm	20 to 100 rpm

* Off is an option for each alarm limit

Invasive Pressure (Optional)

Pressure Amplifier

Isolation voltage: 5 KVDC
Signal range: -30 to 250 mmHg
Sensitivity: 5 µV/V/mmHg
Gain accuracy: ±0.5 percent
Bandwidth: 0 to 10 Hz (-3 dB)
Offset range: ±300 mmHg

Transducer (REF 989803179721)

Operating pressure: -50 to 300 mmHg
Overpressure limits: -400 to 5000 mmHg
Sensitivity: 5 µV/V/mmHg ±1 @ 6 VDC and 22°C (71.6°F)
Zero offset: < ± 25 mmHg
Zero drift: < ±2 mmHg in 8 hours
Input impedance: 300 to 350 ohms
Output impedance: 300 ohms ± 30 ohms

Auto Zero

Range: +300 mmHg
Zero accuracy: ±1.0 mmHg
Response time: 1 second, notification upon completion

Pressure Wave Display

Number of channels: 0, 1 or 2
ABP, PAP and LAP: Numeric display of systolic, diastolic and mean pressures
CVP and ICP: Numeric display of mean pressure only

Pressure Scale

Ranges: (user selectable) 0 to 250 mmHg; 0 to 200 mmHg; 0 to 150 mmHg; 0 to 100 mmHg; 0 to 75 mmHg; 0 to 45 mmHg

Pulse Rate (When derived from P1 or P2)

Range: 30 to 250 bpm
Accuracy: ±2 % of full scale
Resolution: 1 bpm

Alarm Delay

Transducer disconnect: 6 seconds
Pressure disconnect: 6 seconds
High and low pressure: 10 seconds

Alarm Limits

	Lower*	Upper*
When "HR" is derived from P1 or P2	30 to 250 bpm	60 to 250 bpm
Systolic, Mean, Diastolic	- 30 to 250 mmHg; 4.0 to 33.3 kPa	- 30 to 250 mmHg; -4.0 to 33.3 kPa

* Off is an option for each alarm limit

Transducer Connector Pin Compatibility

Pin A: - Signal
Pin B: + Excitation
Pin C: + Signal
Pin D: - Excitation
Pin E: Shield

Anesthetic Agents (Optional)

Side stream, non-dispersive infrared (NDIR) absorption technique, including water trap filtration system and microprocessor control of sample handling and calibration

Simultaneously measured gases (any two of the following, inspired or expired, while also measuring CO_2, N_2O, and O_2)**:** Halothane, Isoflurane, Desflurane, Enflurane, Sevoflurane

Measurement Range

(After maximum warm-up period)
Halothane: 0 to 5.0 VOL%
Isoflurane: 0 to 5.0 VOL%
Desflurane: 0 to 18.0 VOL%
Enflurane: 0 to 5.0 VOL%
Sevoflurane: 0 to 8.0 VOL%
Carbon dioxide: 0 to 10.0 VOL%
Nitrous oxide: 0 to 100 VOL%

Accuracy

(Includes stability and drift)
Halothane: 0 to 1.00 VOL% (±0.15 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); > 5.00 (unspecified)
Isoflurane: 0 to 1.00 VOL% (±0.15 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); > 5.00 (unspecified)
Desflurane: 0 to 1.00 VOL% (±0.15 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); 5.00 to 10.00 VOL% (±0.40 VOL%); 10.00 to 15.00 VOL% (±0.60 VOL%); 15.00 to 18.00 VOL% (±1.00 VOL%); > 18.00 (unspecified)
Enflurane: 0 to 1.00 VOL% (±0.15 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); > 5.00 (Unspecified)
Sevoflurane: 0 to 1.00 VOL% (±0.15 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); 5.00 to 8.00 VOL% (±0.40 VOL%); > 8.00 (Unspecified)
Carbon dioxide: 0 to 1.00 VOL% (±0.10 VOL%); 1.00 to 5.00 VOL% (±0.20 VOL%); 5.00 to 7.00 VOL% (±0.30 VOL%); 7.00 to 10.00 VOL% (±0.50 VOL%); > 10.00 (Unspecified)
Nitrous oxide: 0 to 20 VOL% (±2.00 VOL%); 20.0 to 100 VOL% (±3.00 VOL%)

Interference Gas

CO_2: N_2O, O_2, any agent = $0.1\%_{ABS}$ inaccuracy allowance for each
N_2O: CO_2, O_2, any agent = $0.1\%_{ABS}$ inaccuracy allowance for each
Agents: CO_2 = $0\%_{ABS}$ inaccuracy allowance; N2O, O_2, second agent = $0.1\%_{ABS}$ inaccuracy allowance for each

Flow Rate

Adult and pediatric: 200 ±20 ml per min
Neonate: 150 ±15 ml per min
Maximum specified interval for intervention of water (hours at specified minimum sample flow rate)**: AGENT mode -** Adult and pediatric is 17 hours @ 200 ml/min, 37°C, 100% RH;

neonate is 17 hours @ 120 ml/min, 37°C, 100% RH; **CO_2 mode** - 8 hours @ 50 mL/min ±10 ml/min

System Response and Rise Times

As measured from patient gas input of the complete pneumatic circuit, including tubing, from 10 to 90 percent of measured levels

Adult Cannula:

	System Response (sec)	Rise Time (sec)
Halothane	11.56	5.77
Isoflurane	6.71	0.88
Desflurane	6.33	0.57
Enflurane	7.55	1.75
Sevoflurane	6.45	0.62
CO2	6.62	0.61
Oxygen	6.99	1.02
Nitrous Oxide	6.28	0.25

Infant Cannula:

	System Response (sec)	Rise Time (sec)
Halothane	15.95	8.63
Isoflurane	9.26	1.70
Desflurane	6.47	0.61
Enflurane	11.98	4.75
Sevoflurane	6.48	0.62
CO2	6.51	0.48
Oxygen	8.61	1.13
Nitrous Oxide	7.95	0.72

Adult Divided Cannula:

	System Response (sec)	Rise Time (sec)
Halothanelar	20.81	14.18
Isoflurane	10.99	3.91
Desflurane	7.38	0.64
Enflurane	13.83	7.11
Sevoflurane	7.48	0.78
CO2	7.57	0.64
Oxygen	8.02	1.07
Nitrous Oxide	7.16	0.51

Infant Divided Cannula:

	System Response (sec)	Rise Time (sec)
Halothane	9.98	3.95
Isoflurane	6.75	0.89
Desflurane	6.25	0.60
Enflurane	7.32	1.37
Sevoflurane	5.45	0.67
CO2	5.49	0.49
Oxygen	7.25	0.84
Nitrous Oxide	6.51	0.39

Data sample rate: 25 Hz
Full accuracy respiration rate (range permitting specified gas accuracy)**:** 2 to 60 rpm
Total respiration range: 2 to 100 rpm; accuracy is unspecified from 60 to100 rpm
Relevant interference: 0.5 mmHg equivalent with 37.5°C saturated with H_2O (0.1 % relative max)
Display resolution: 0.1 % volume
Maximum warm-up time: 10 minutes; ISO accuracy achieved in less than 45 seconds of activation
Auto ID threshold (full accuracy mode)**:** 0.15 % (Primary agent ID); 0.3 % (Secondary agent ID)
Multiple agents alarm threshold: 0.3 % (0.5 % during ISO accuracy mode) or 5% $_{REL}$ (10 % for isoflurane) of primary agent if primary agent > 10 % (For halothane add 0.1 %$_{ABS}$ to threshold values)
CO_2 ambient pressure compensation range: 500 to 900 mmHg
Pressure compensation: Unaffected by cyclical pressures of up to 10 kPa as, apart from the described automatic pressure compensation, the pump automatically regulates flow so that not only gas readings but also gas sample flow is unaffected
Calibration interval: Calibration verification (as described in service instructions) must be performed at one year intervals

Alarm Limits

	Lower*	Upper*
$EtCO_2$	5 to 60 mmHg; 0.6 to 8.0 kPa	5 to 76 mmHg; 0.7 to 10.1 kPa
$FiCO_2$	No limit	0 to 20 mmHg; 0 to 2.7 kPa
FiN_2O	No limit	0 to 80 %
Et Halothane	0.1 to 5.0 VOL%	0.1 to 5.0 VOL%
Fi Halothane		
Et Isoflurane		
Fi Isoflurane		
Et Desflurane	0.1 to 18.0 VOL%	0.1 to 18.0 VOL%
Fi Desflurane		
Et Enflurane	0.1 to 5.0 VOL%	0.1 to 5.0 VOL%
Fi Enflurane		
Et Sevoflurane	0.1 to 8.0 VOL%	0.1 to 8.0 VOL%
Fi Sevoflurane		
FiO_2	18 to 100 %	20 to 100 %

* Off is an option for each alarm limit

CO_2

Range: 0 to 76 mmHg (0 to 10.1 kPa)
Resolution: 1 mmHg (0.1 kPa)

O_2

Range: 0 to 100 %
Resolution: 1 %
Signal Output (at constant temperature and pressure): 10 mV ±1.5 mV @ 20° C / 20.95 % O_2
Maximum response time (21 to 100 % step change through patient sampling line as seen in WPU gas monitor window)**:** < 7.3 seconds (adult and pediatric); < 8.2 seconds (neonate)
Accuracy (includes stability and drift, full scale gas measurement performance met after the maximum warm-up period)**:** ±1 % (0 to 40 %); ±2 % (40 to 60 %); ±3 % (60 to 80 %); ±4 % (80 to 100 %)
Offset: ±1 %

O_2 interfering gas effects

N_2O: < 0.3 VOL% @ 80 VOL% N_2O
CO_2: < 0.3 VOL% @ 5 VOL% CO_2
Halothane: < 0.3 VOL% @ 5 VOL% halothane
Enflurane: < 0.3 VOL% @ 5 VOL% enflurane
Isoflurane: < 0.3 VOL% @ 5 VOL% isoflurane
Desflurane: < 0.3 VOL% @ 18 VOL% desflurane
Sevoflurane: < 0.3 VOL% @ 8 VOL% sevoflurane
Acetone: < 0.3 VOL% @ 1 VOL% acetone
Ethanol: < 0.3 VOL% @ 0.1 VOL% ethanol
Helium: < 0.3 VOL% @ 80 VOL% helium
Methane: < 0.3 VOL% @ 0.1 VOL% methane
Nitric oxide: < 0.3 VOL% @ 50 ppm nitric oxide

Oxygen Sensor

Operating temperature: 15 to 35 °C (59 to 95°F)
Expected operating life: Use by the expiration date printed on sensor and its packaging

Respiration (Pneumatic)

Displayed numerically by detecting the patient's abdominal or chest wall motion through a pneumatic bellows placed at the patient's chest. No user adjustable options, including alarms, as this parameter is not intended for vital sign monitoring.

Respiration rate measurement range: 0 to 60 rpm
Respiration rate resolution: 1 rpm
Respiration rate accuracy: ± 1 rpm

Temperature (Optional)

For use with the FlexTEMP II Sensor
Channel: One
Units: Celsius and Fahrenheit
Range: 20.0 to 44.0°C (68.0 to 111.2°F)
Resolution: 0.1°C (0.1°F)
Accuracy: ±0.5°C (±0.9°F)
Response time: The measuring time to obtain a steady-state reading within the manufacturer's accuracy specifications is within 15 seconds, compliant to ISO 80601-2-56.
Numeric display update time: 2 seconds
Sensor type: Fiber-optic, multiple-use (when used with single-use sterilized jackets)
Application site: Axillary, esophageal, rectal
Measurement mode: Direct
Alarm Limits

Lower*	Upper*
20.0 to 44.0°C; 68.0 to 111.2°F	20.0 to 44.0°C; 68.0 to 111.2°F

Non-invasive Blood Pressure

Oscillometric method (with inflatable cuff) determines systolic, diastolic and mean arterial pressures, and pulse rate.

Patient Types: Adult, pediatric, and neonate
Unit of measure: Millimeters of mercury (mmHg) or kilopascals** (kPa)
Cuff inflation pressure: Initially 165 mmHg (22 kPa) for Adult, 130 mmHg (17.3 kPa) for Pediatric, and 100 mmHg (13.3 kPa) for Neonate; all pressures are ± 15 mmHg (2 kPa); Subsequent inflation pressures determined by the previous NIBP measurement
Overpressure protection: release of cuff pressure if inflation pressure exceeds 300 mmHg (40 kPa) for Adult and Pediatric modes, and 150 mmHg (20 kPa) for Neonate mode

Measurement Range

	Adult	Pediatric	Neonate
Systolic	30 to 270 mmHg; 4 to 36 kPa	30 to 180 mmHg; 4 to 24 kPa	30 to 130 mmHg; 4 to 17.3 kPa
Diastolic	10 to 245 mmHg; 1.3 to 32.7 kPa	10 to 150 mmHg; 1.3 to 20 kPa	10 to 100 mmHg; 1.3 to 13.3 kPa
Mean	20 to 255 mmHg; 2.7 to 34 kPa	20 to 160 mmHg; 2.7 to 21.3 kPa	20 to 120 mmHg; 2.7 to 16 kPa

Accuracy

Pressure measurement accuracy: Maximum mean error ±5 mmHg (± 0.6 kPa) with a standard deviation of less than 8 mmHg (1 kPa)
Pressure measurement resolution: 1 mmHg (0.1 kPa)
Pressure transducer range: 0 to 300 mmHg (0 to 40 kPa)

Modes

Manual: Immediate upon operator command
Automatic: Determinations automatically made with selectable intervals of 1, 2, 3, 5, 10, 15, 20, and 30 minutes

Alarm Limits

		Lower*	Upper*
Systolic	Adult	30 to 270 mmHg; 4.0 to 36.0 kPa	30 to 270 mmHg; 4.0 to 36.0 kPa
	Pediatric	30 to 180 mmHg; 4.0 to 24.0 kPa	30 to 180 mmHg; 4.0 to 24.0 kPa
	Neonate	30 to 130 mmHg; 4.0 to 17.3 kPa	30 to 130 mmHg; 4.0 to 17.3 kPa
Diastolic	Adult	10 to 245 mmHg; 1.3 to 32.7 kPa	10 to 245 mmHg; 1.3 to 32.7 kPa
	Pediatric	10 to 150 mmHg; 1.3 to 20.0 kPa	10 to 150 mmHg; 1.3 to 20.0 kPa,
	Neonate	10 to 100 mmHg; 1.3 to 13.3 kPa	10 to 100 mmHg; 1.3 to 13.3 kPa
Mean	Adult	20 to 255 mmHg; 2.7 to 34.0 kPa	20 to 255 mmHg; 2.7 to 34.0 kPa
	Pediatric	20 to 160 mmHg; 2.7 to 21.3 kPa	20 to 160 mmHg; 2.7 to 21.3 kPa
	Neonate	20 to 120 mmHg; 2.7 to 16.0 kPa	20 to 120 mmHg; 2.7 to 16.0 kPa

* Off is an option for each alarm limit
***For kilopascals (kPa), allow ± 1 least significant digit to accommodate round-off error for calculated values.*

Gating

Parameter result outputs to the MRI system as data and discrete signals.
Digital pulses (parameter event-associated signals):

- ECG (3.3 to 5.0 V p-p signal, pulse duration 10 ms ±3 ms)
- SpO_2 (3.3 to 5.0 V p-p signal, pulse duration 10 ms ±3 ms)
- Negative pulses (-3.3 to -5.0 V p-p signals), other characteristics same as above

Analog waveforms (monitored parameter representative signals)**:**

- ECG (1 mV/mV scaling, 5 mA maximum current, 20 mV maximum output voltage)
- ECG (1 V/mV scaling, ± 5 V maximum output voltage, 5 mA maximum current)
- IBP (200 mV maximum output voltage)
- Respiration (± 5 V maximum output voltage, 5 mA maximum current, 1 V p-p signal voltage)
- SpO2 IR/red (1 V/mV scaling, 40 mV maximum output voltage)
- SpO2 IR/red (2 V maximum output voltage)

Accessories

(Original part number in parenthesis where applicable.)

AGENT

989803152561 (9012) - Cannula, Disp, Adult
989803152601 (9016) - Cannula, Disp, Adult
989803152621 (9016B) - Cannula, Disp, INT INF, (Divided)
989803152631 (9016C) - Cannula, Disp, PED, (Divided)
989803152611 (9016A) - Cannula, Disp, Infant, (Divided)
989803152591 (9015) - Cannula, Disp, INT Infant
989803152571 (9013) - Cannula, Disp, PED
989803152581 (9014) - Cannula, Disp, Infant
989803162051: Anesthetic Oxygen (O_2) Sensor
989803152671 (94012) – Kit, Disposable, Water Trap, 3160
989803152661 (94018): Kit, Sample, Agents, 3160

CO2 Cannulas

989803183241 - LoFlo Sample Line, Adult Cannula, Box 20
989803183251 - LoFlo Sample Line, Ped. Cannula, Box 20
989803183261 - LoFlo Sample Line, Neo. Cannula, Box 20
989803183271 - LoFlo Line, Adu Dvd Cannula, Box 20
989803183281 - LoFlo Line, Ped Dvd Cannula, Box 20
989803183291 - LoFlo Line, Adu Airway Adpt, Box 20
989803185331 - LoFlo Sample Line, Adult Cannula, Box 100
989803185341 - LoFlo Sample Line, Ped Cannula, Box 100
989803185351 - LoFlo Sample Line, Neo Cannula, Box 100
989803185361 - LoFlo Line, Adu Dvd Cannula, Box 100
989803185371 - LoFlo Line, Ped Dvd Cannula, Box 100
989803185381 - LoFlo Line Adu Airway Adpt, Box 100

ECG

989803152291 (9009) – Gel, ECG/EEG Skin Prep, Tube, 3-pack
989803193721 - Expression MR ECG Leads, AAMI, CV
989803193731 - Expression MR ECG Leads, AAMI, Standard
989803193741 - Expression MR ECG Leads, AAMI, Neonatal
989803193751 - Expression MR ECG Leads, IEC, CV
989803193761 - Expression MR ECG Leads, IEC, Standard
989803193771 - Expression MR ECG Leads, IEC, Neonatal
989803179031 - QUADTRODE MRI ECG Pad, 25/box
989803179041 - ELCTRD, MRI ECG, QUTRD.CV, 25/box
989803179051 - ELCTRD, MRI, NEO.QUDTRD, 25/box
989803192761 - Wireless ECG Patient Module (GEN 3) 1-5
989803194341 - Wireless ECG Patient Module (GEN 3) 6-10

Gating

989803152821 (9292) - CAB, Digital Gating, GE, 3160
989803152831 (9291) - CAB, Gating, Siemens, 3160
989803152851 (9293) - CAB, Dig. Gating, HIT/TOSH, 3160
989803195521 – Universal Gating Interface

Invasive Blood Pressure

989803194601 - Expression MR IBP Transducer Cable, 5 Ft
989803194631 - Expression MR IBP DPT Kit, A/P, Box 20
989803194641 - Expression MR IBP DPT Kit, I/N, Box 20

Non-invasive Blood Pressure (NIBP) Cuffs

989803182611 - NIBP Cuff, Single Lumen, Infant
989803182621 - NIBP Cuff, Single Lumen, Pediatric
989803182631 - NIBP Cuff, Single Lumen, Small Adult
989803182641 - NIBP Cuff, Single Lumen, Adult
989803182651 - NIBP Cuff, Single Lumen, Adult-L
989803182661 - NIBP Cuff, Single Lumen, LRG Adult
989803182671 - NIBP Cuff, Single Lumen, LRG Adult-L
989803182681 - NIBP Cuff, Single Lumen, Thigh

Disposable Non-invasive Blood Pressure (NIBP) Cuffs

989803182511 - NIBP Cuff, Single Lumen, Infant, Disp
989803182521 - NIBP Cuff, Single Lumen, Pediatric, Disp
989803182531 - NIBP Cuff, Single Lumen, Small Adult, Disp
989803182541 - NIBP Cuff, Single Lumen, Adult, Disp
989803182551 - NIBP Cuff, Single Lumen, Adult-L, Disp
989803182561 - NIBP Cuff, Single Lumen, LRG Adult, Disp
989803182571 - NIBP Cuff, Single Lumen, LRG Adult-L, Disp
989803182581 - NIBP Cuff, Single Lumen, Thigh, Disp
989803183171 - NIBP Cuff, Single Lumen, Neo #1, Disp
989803183181 - NIBP Cuff, Single Lumen, Neo #2, Disp
989803183191 - NIBP Cuff, Single Lumen, Neo #3, Disp
989803183201 - NIBP Cuff, Single Lumen, Neo #4, Disp
989803183211 - NIBP Cuff, Single Lumen, Infant #5, Disp

Non-invasive Blood Pressure (NIBP) Hoses

989803183221 - Adult Pressure Interconnect Hose
989803183231 - Neonatal Pressure Interconnect Hose

Respiration (Pneumatic)

989803152791 (94023) - Pneumograph, Chest, NM, 3160

SpO_2

989803161991 - Quick Connect SpO_2 Probe, MRI
989803166531 - Quick Connect SpO_2 Clip, Adult
989803166541 - Quick Connect SpO_2 Clip, Pediatric
989803166551 - Quick Connect SpO_2 Grip, Adult, 20/box
989803166561 - Quick Connect SpO_2 Grip, Ped, 20/box
989803166571 - Quick Connect SpO_2 Grip, Infant, 20/box
989803166581 - Quick Connect SpO_2 Grip, Neo, 20/box
989803192771 - Wireless SpO_2 Patient Module (Gen 3) 1-5
989803194331 - Wireless SpO_2 Patient Module (Gen 3) 6-10

System

989803191341 - Battery, Module (Gen 3)
989803169491 - Battery, MRI, 14.8V, 5.08 AH, UL
865471 - Expression Information Portal - IP5
989803176521 - Advanced Communications Option
453564177501 - European Line Cord
989803168211 - North American Line Cord
989803168221 - Cord, Jumper, 25 Feet
989803173901 - Brazilian Power Cord, 3 meter
989803174171 - UK Line Cord, 3 meter
989803181291 - Power Cord, AUS/NZL, 3 meter
989803181321 - Power Cord, S Africa, 3 meter
989803181331 - Power Cord, Danish, 3 meter
989803181341 - Power Cord, Israeli, 3 meter
989803181351 - Power Cord, Argentina, 3 meter
989803181361 - Power Cord, Swiss, 3 meter

Temperature

989803194511 - FlexTEMP II Sensor (Esophageal/Rectal/Axillary, Direct Mode)
989803168891 - Surgical Lubricant, 12 pack
989803178181 - FlexTEMP System, Jacket (Box 10)

User Guides

989803193191 - Danish*
989803193201 - Dutch*
989803193211 - English*
989803193221 - Finnish
989803193231 - French*
989803193241 - German*
989803193251 - Indonesian
989803193261 - Italian*
989803193271 - Japanese
989803193281 - Korean
989803193291 - Norwegian*
989803193301 - Polish
989803193311 - Brazilian Portuguese*
989803193321 - Russian
989803193331 - Spanish*
989803193341 - Swedish*
989803193351 - Traditional Chinese
989803193361 - Turkish
989803196981 - Czech
989803198661 - Bulgarian
989803198671 - Hungarian
989803198681 - Latvian
989803198691 - Lithuanian
989803198701 - Romanian
989803198711 - Slovakian
989803198821 - Estonian
* - User interface software also translated in these languages

Miscellaneous

989803196881 **-** Quick Reference Guide
989803195211 **-** Service Manual

For more information about the Expression Model MR400 MRI Patient Monitoring System or any of our complete solution products, please contact us. We are glad to hear from you.

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