The Expression MR200 MRI Patient Monitoring System is designed to assist clinicians in monitoring patient vital signs in the dynamic magnetic resonance environment. The Expression MR200 combines wireless communication, radio frequency shielding and digital signal processing to address the challenges associated with patient monitoring in the MR environment.

The Expression MR200 consists of these primary components:
- Traditional Roll-Around Cart
- Wireless ECG (wECG) module
- Wireless SpO2 (wSpO2) module
Optional Components

- Expression Information Portal (IPS)

Features and Benefits

- Integral color LCD display for patient information
- Intuitive graphical user interface
- Colored waves and large numerics
- Portable 8-hour battery
- Simultaneous display of up to five parameters, and four waveforms and associated values
- Visual and audible alarm signals, pulse tones, and system status messages
- Gating, both digital pulse and analog waveform
- Expression Information Portal (IPS, optional)
- Wireless remote printing to IPS (optional)
- Wireless gating (with Invivo wireless-equipped MRI systems)

System Parameters

The MR200 can include the following vital sign parameters:

- Electrocardiogram (ECG), dual channel
- Blood oxygen saturation/pulse oximetry (SpO2)
- Non-invasive blood pressure (NiBP)
- End-tidal and inspired CO2
- Respiration from CO2 or bellows

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 or pulse oximetry
- Pulse oximeter: Pulse rate, pulse waveform, and percent saturation
- CO2: End-tidal and inspired
- NiBP: Systolic, mean, and diastolic pressures
- Bellows respiration: Rate derived from chest bellows
- Trends: Heart rate, respiration rate, NiBP (systolic, diastolic, mean), CO2, and SpO2
- Respiration: Rate derived from CO2
- Time: Battery-backed quartz clock

While 50 mm/second gives 4.6 seconds. For respiration, a speed of 0.33, 1.56, 3.13, 6.25, 12.5 or 25 mm/second is used.

- Waveform display mode: Fixed trace, moving erase bar
- Waveform display height: ≥ 19 mm
- “Full Screen” Display Height: ≥ 75 mm
- Audio speaker

User Interface

Four groups of data are displayed:

- Informational
- Vital signs traces
- Vital signs numerics
- System status

Application Features

Trends

- Automatically can store the parameter trend information for heart rate, NiBP, SpO2, CO2 and respiration
- Trend arrows graphically indicate an increasing, decreasing or stable parameter
- Trend feature may be operated to graph multiple or individual trends
- Multi-trends can offer a graphical representation of the selected parameters from the following available parameters:
  - HR
  - NiBP
  - SpO2
  - EtCO2
  - RESP [CO2]

Alarms

- One alarm severity (high)
  - Visual alarm indicators: flashing numerics, alarm messages, icons
  - Audible alarms, user-configurable for volume, tone, and silence
- Configurable alarm limits
- Auto-set allows alarm limits to be quickly set
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 ES60601-1. Certified to CAN/CSA-C22.2 No. 60601-1
- Complies to IEC 60601-1, IEC 60601-1-2, IEC 60601-1-6, IEC 60601-1-8 (where applicable), IEC 60601-2-27 (where applicable), IEC 80601-2-30, IEC 60601-2-49, ISO 80601-2-55 (where applicable), ISO 80601-2-61 (where applicable), and ISO 10993-1, 5, and 10
- Defibrillator protection up to 5 KV

Physical Specifications

Height
- Cart: 54.22 inches (137.71 cm)
- Wireless ECG module: 4.7 inches (11.9 cm)
- Wireless SpO2 module: 5.5 inches (13.9 cm)

Width
- Cart: 22.15 inches (56.26 cm)
- Wireless ECG module: 2.5 inches (6.4 cm)
- Wireless SpO2 module: 2.5 inches (6.4 cm)

Depth
- Cart: 25.25 inches (64.14 cm)
- Wireless ECG module: 0.91 inches (2.3 cm)
- Wireless SpO2 module: 0.91 inches (2.3 cm)

Weight
- Cart: 74.06 pounds (33.59 kg)
- Wireless ECG module: 5.4 ounces (158.8 g)
- Wireless SpO2 module: 5.4 ounces (158.8 g)

Electrical Specifications

Power Requirements
- Operating voltage range: 100 – 240 VAC
- Frequency range: 47 – 63 Hz
- Current: 1.5 A @ 115 VAC / 0.7 A @ 240 VAC
- Power consumption, maximum: ≤ 65 Watts

Battery Type
- Cart: Lithium-Ion
- Module: Lithium polymer

Battery Operation Time
- 8 hours

Battery Capacity
- Cart: 75 Wh
- Module: 3.1 Wh

Environmental Specifications

- Operating temperature range: 10 – 35°C (50 – 95°F)
- Relative humidity range: 15 – 80 percent, non-condensing
- Storage and transport temperature range:
  - Batteries: 0 – 40°C (32 – 104°F)
  - Cart: -20 – 50°C (-4 – 122°F)
  - Wireless modules: -25 – 75°C (-13 – 167°F)
  - Accessories: -20 – 60°C (-4 – 140°F)
- Altitude range: From sea level up to 10,000 feet (3048 m) or 708 mbar
- Storage and transport pressure range: 708 – 1020 mbar

Measurement Specifications

Electrocardiogram Channel (ECG)

ECG Amplifier
- Protected against defibrillator and electrosurgery 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)

Heart Rate
- Range: 30 – 249 BPM (adult); 30 – 300 BPM (pediatric and neonate)
- Resolution: 1 beat per minute (BPM)
- Accuracy:
  - In the absence of MRI gradient artifact: ± 1 percent or ± 1 BPM, whichever is greater
  - In the presence of MRI gradient artifact: ± 1 percent from 30 – 200 BPM; ± 1.5 percent from 200 – 250 BPM; and (neonate only) ± 2.0 percent from 251 – 300 BPM

Cardiotach
- Sensitivity (Monitor filter):
  - Adult ECG mode: > 200 µV
  - Neonate/Pediatric ECG mode: > 100 µV
- Bandwidth: Monitor: 0.5 – 40 Hz
- Tall T-wave rejection capability for heart rate indication: 2 mV with a 1 mV QRS amplitude
Patient Types
- Rate systolic, diastolic and mean arterial pressures, and pulse.

Oscillometric method (with inflatable cuff) determines alarm limits.

Test / Calibrations
- Square wave test signal: 60 BPM ± 1 BPM, 1 mV ± 10 percent

Pulse Oximeter
- Pitch of pulse tone is modulated by saturation value.
- Saturation range: 1 – 100 percent
- Saturation value resolution: 1 percent
- Saturation accuracy: ± 3 percent at 70 – 100 percent (the specified accuracy is the RMS difference between the measured and reference values)
- Pulse accuracy: ± 2 percent or ± 1 BPM, whichever is greater
- Pulse rate range: 30 – 250 BPM
- Pulse rate resolution: 1 BPM
- Data update period: 5, 10, or 15 seconds (according to the SPO2 Averaging Time setting)
- Data Update Period during Alarm: 9, 14, or 19 seconds, maximum (4 seconds plus the SPO2 Averaging Time setting of 5, 10, or 15 seconds)
- Wavelength range: 500 – 1000 nm (information about wavelength range can be especially useful to clinicians)
- Emitted light energy: < 15 mW
- Pulse oximeter calibration range: 70 – 100 percent

Alarm Limits
- SpO2 alarm limits:
  - Low: Off, or 50 – 99 percent
  - High: 70 – 99 percent, or off
- When “HR” is derived from SpO2:
  - Low: Off, or 30 – 249 BPM
  - High: 60 – 249 BPM, or off

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

Pneumatic System
- 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 last 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
- Systolic:
  - Adult: 30 – 270 mmHg (4 – 36 kPa)
  - Pediatric: 30 – 180 mmHg (4 – 24 kPa)
  - Neonate: 30 – 130 mmHg (4 – 17.3 kPa)
- Mean arterial:
  - Adult: 20 – 255 mmHg (2.7 – 34 kPa)
  - Pediatric: 20 – 160 mmHg (2.7 – 21.3 kPa)
  - Neonate: 20 – 120 mmHg (2.7 – 16 kPa)
- Diastolic:
  - Adult: 10 – 245 mmHg (1.3 – 32.7 kPa)
  - Pediatric: 10 – 150 mmHg (1.3 – 20 kPa)
  - Neonate: 10 – 100 mmHg (1.3 – 13.3 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 – 300 mmHg (0 – 40 kPa)

Modes
- Manual: Immediate upon operator command
- Automatic: Determinations automatically made with selectable intervals of 1, 2, 2.5, 3, 5, 10, 15, 20, 30 and 45 minutes, and 1, 2 and 4 hours

Alarm Limits
- Systolic:
  - Adult and pediatric:
    - Lower: Off, or 46 – 254 mmHg (Off, or 6.1 – 33.9 kPa)
    - Upper: 46 – 254 mmHg, or off (6.1 – 33.9 kPa, or off)
  - Neonate:
    - Lower: Off, or 46 – 124 mmHg (Off, or 6.1 – 16.5 kPa)
    - Upper: 46 – 124 mmHg, or off (6.1 – 16.5 kPa, or off)
- Mean Arterial:
  - Adult and pediatric:
    - Lower: Off, or 26 – 239 mmHg (Off, or 3.5 – 31.9 kPa)
    - Upper: 26 – 239 mmHg, or off (3.5 – 31.9 kPa, or off)
Method for determining end tidal CO2 measurement: microprocessor control of sample handling and calibration. Side stream non‐dispersive infrared absorption technique, accommodate round

- Adult and pediatric:
  - Lower: Off, or 16 – 224 mmHg (Off, or 2.1 – 29.9 kPa)
  - Upper: 16 – 224 mmHg, or off (2.1 – 29.9 kPa, or off)
- Neonate:
  - Lower: Off, or 16 – 84 mmHg (Off, or 2.1 – 11.2 kPa)
  - Upper: 16 – 84 mmHg, or off (2.1 – 11.2 kPa, or off)

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

CO2 (Optional)

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 CO2 measurement:

- Output: CO2 waveform, EtCO2 and FiCO2 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
- CO2 unit of measure: Millimeters of mercury (mmHg) or kilopascals* (kPa)
- CO2 resolution: 1 mmHg (0.1 kPa)
- Flow rate: 50 mL per minute ± 10 mL per minute
- Data sample rate: 100 Hz
- End‐tidal CO2 (EtCO2) measurement range (in which the accuracy specification is met): 0 – 76 mmHg (0 – 10.1 kPa) for respiration rates ranging from 4 – 60 breaths per minute, inclusive
- Inspired CO2 (FiCO2) measurement range: 3 – 50 mmHg (0.4 – 6.7 kPa) (method: lowest reading of the CO2 waveform in the previous 20 seconds)
- CO2 accuracy: ± 4 mmHg (± 0.5 kPa) or ± 12 percent, whichever is greater
- CO2 stability:
  - 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 percent, whichever is greater
- Respiration resolution: 1 breath per minute

- Respiration rate range (in which the respiration accuracy specification is met): 4 – 100 breaths per minute, inclusive
- Response (rise) time (as measured from the patient gas input of the complete pneumatic circuit, including tubing, from 10 – 90 percent of the measured CO2 levels):
  - Adult and pediatric: ≤ 800 ms
  - Neonate: ≤ 440 ms
- Compensations (automatic CO2 ambient pressure compensation 400 to 800 mmHg [53.3 – 106.6 kPa]):
  - For expired O2 Balance gas (N2, N2O, O, He) and anesthetic agents
  - Uses gas compensation information to correct the raw carbon dioxide value
- Anesthetic agent effects (MAC levels):
  - Sensitivity (uncompensated): Accuracy maintained for halogenated anesthetic agents present at accepted Minimum Alveolar Concentration clinical levels
  - Sensitivity (compensated): Testing at regulatory standards (i.e., ISO 21647, ASTM F1456, IEC/CDV 60601-2-55) currently in process
- Cross‐sensitivity compensation error (additional worst case error when compensation for O2, N2O anesthetic agents, or helium is correctly selected for the actual fractional gas constituents present):
  - 0 – 40 mmHg: ± 1 mmHg additional error (0 – 5.3 kPa: ± 0.1 kPa additional error)
  - 41 – 70 mmHg: ± 2.5 mmHg additional error (5.5 – 9.3 kPa: ± 0.3 kPa additional error)
  - 71 – 100 mmHg: ± 4 mmHg additional error (9.5 – 13.3 kPa: ± 0.5 kPa additional error)
  - 101 – 150 mmHg: ± 5 mmHg additional error (13.5 – 20 kPa: ± 0.6 kPa additional error)
- Quantitative effects of gas sample humidity or condensate**:
  - 0 – 40 mmHg: ± 2 mmHg (0 – 5.3 kPa: ± 0.2 kPa)
  - 41 – 70 mmHg: ± 5 percent (5.5 – 9.3 kPa: ± 5 percent)
  - 71 – 100 mmHg: ± 8 percent (9.5 – 13.3 kPa: ± 8 percent)
  - 101 – 150 mmHg: ± 10 percent (13.5 – 20 kPa: ± 10 percent)

**With appropriate compensations applied.
Alarm Limits

- **End-tidal CO2:**
  - Lower: Off, or 5 – 60 mmHg (Off, or 0.6 – 7.9 kPa)
  - Upper: 5 – 80 mmHg, or off (0.6 – 10.6 kPa, or off)
- **Inspired CO2:**
  - Fixed: 25 mmHg (3.2 kPa)
- **Respiration:**
  - Off, or 4 – 40 breaths per minute
  - 20 – 99 breaths per minute, or off

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

Respiration

- 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

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)
  - SpO2 (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)
  - 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)

Options

- F01: Basic (NI BP, ECG, SpO2)
- F02: Basic (NI BP, ECG, SpO2) and CO2, RESP

Accessories

**CO2**

- 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
- 989803185311: LOFLO SAMPLE LINE, ADULT CANNULA,BAX 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: GEL, ECG/EEG, SKIN PREP, TUBE, 3-PACK
  - (Original part number: 9009)
- 989803152301: CAB, 4 LD, MRI ECG
  - (Original part number: 9224)
- 989803152331: CAB, 4 LD, NEO.MRI ECG
  - (Original part number: 9222)
- 989803152351: CAB, 4 LD, CV MRI ECG
  - (Original part number: 9223)
- 989803176381: ADVANCED APPS ECG CABLE
- 989803170121: ADVANCED FILTER ECG CABLE
- 989803179031: QUADROTE MRI ECG PAD, 25/BOX
- 989803179041: ELCTRDR, MRI ECG, QUTRDR.CV, 25/BOX
- 989803179051: ELCTRDR, MRI, NEO.QUDTRD, 25/BOX
- 989803183661: WIRELESS WECG PATIENT MODULE
- 989803185441: CAB, 4 LD, NEO.MRI ECG, IEC
- 989803185451: CAB,4 LD,CV MRI ECG, IEC
- 989803185461: CAB,4 LD,MR-I ECG, IEC
- 989803185471: ADVANCED FILTER ECG, IEC

Ordering Information

**Standard Features, 866120**

- A01: Standard Accessories
- 989803185481: ADVANCED APPS ECG CABLE, IEC

Gating
- 989803152821: CAB, DIGITAL GATING, GE, 3160
  (Original part number: 9292)
- 989803152831: CAB, GATING, SIEMENS, 3160
  (Original part number: 9291)
- 989803152841: CAB, GATING, PHILIPS ACH, 3160
  (Original part number: 9294)
- 989803152851: CAB, DIG.GATING, HIT/TOSH, 3160
  (Original part number: 9293)

Non-invasive Blood Pressure (NiBP)
- 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
- 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
- 989803182591: NIBP CUFF, SINGLE LUMEN, SAMPLE KIT, 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

- 989803183221: ADULT PRESSURE INTERCONNECT HOSE
- 989803183231: NEONATAL PRESSURE INTERCONNECT HOSE

Pneumatic Respiration
- 989803152791: PNEUMOGRAPH, CHEST, NM, 3160
  (Original part number: 94023)

Power
- 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

SpO2
- 989803161991: QUICK CONNECT SPO2 PROBE, MRI
- 989803183541: WIRELESS SPO2 PATIENT MODULE
- 989803166531: QUICK CONNECT SPO2 CLIP, ADULT
- 989803166541: QUICK CONNECT SPO2 CLIP, PEDIATRIC
- 989803166551: QUICK CONNECT SPO2 GRIP, ADULT, 20/BOX
- 989803166561: QUICK CONNECT SPO2 GRIP, PED, 20/BOX
- 989803166571: QUICK CONNECT SPO2 GRIP, INFANT, 20/BOX
- 989803166581: QUICK CONNECT SPO2 GRIP, NEO, 20/BOX

System
- 989803152881: BATT.3.7V, WRLS.PAT.MDLE.
  (Original part number: 9065)
- 989803169491: BATTERY, MRI, 14.8V, 5.08 AH, UL

Miscellaneous
- MP05: PAPER, THERMAL ARRAY, BLK, 50MM, OMNI
For more information about the Philips Expression MR200 or any of our complete solution products, please contact us. We are glad to hear from you.

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