Philips Medical Systems’ M4735A HeartStart XL offers advanced and basic life-support clinicians a compact, lightweight, easy-to-use defibrillator/monitor with both Manual and AED capabilities. HeartStart XL features Philips’ patented SMART Biphasic waveform, ECG monitoring, synchronized cardioversion, and optional non-invasive pacing and SpO2.

A biphasic waveform is energy delivered in two phases. During the first phase, the electrical current passes through the heart muscle, reverses direction, and then passes through the heart a second time. This efficient transmission of energy requires less current than that delivered by a monophasic waveform.

Manual Mode operation is as easy as 1-2-3:
1 - Select an energy level from 2 to 200 Joules.
2 - Charge the unit.
3 - Deliver the shock.

The HeartStart XL charges to its highest energy level in less than 3 seconds. ALS providers can also perform synchronized cardioversion and deliver non-invasive pacing therapy.

In AED Mode, the HeartStart XL meets the needs of BLS users by offering a range of functions from basic AED to AED with monitoring. BLS clinicians will find these intuitive AED features supported by straightforward voice prompts and displayed text messages.

The HeartStart XL records a patient summary in either mode of operation. Patient data such as continuous ECG, shocks and alarm violations are stored in the unit’s internal memory. Downloading and reporting data is available by using a data card. The Event Review Pro data management system allows authorized users to edit, store, and print reports.

The HeartStart XL is designed to meet a wide variety of resuscitation and monitoring needs in one lightweight, easy-to-use device.
Features

Standard Features

- SMART Biphasic waveform for defibrillation therapy
- ECG monitoring through pads and separate monitoring electrodes
- Alarms on HR limits and shockable rhythms
- Synchronized cardioversion
- Manual and AED operation
- Built-in 50 mm strip chart printer
- Bright Liquid Crystal Display (LCD) display for viewing waveforms and messages
- Internally stored event summary which may be printed
- Voice prompts in AED mode
- Adjustable ECG size
- Adjustable volume
- Setup mode, automatic self-tests and error handling
- Integrated AC power

Optional Features

- SpO₂/Pulse Oximetry with alarms
- Non-invasive pacing (using a monophasic truncated exponential current waveform)
- 5-lead ECG monitoring cable, AAMI or IEC labeling

Standard Accessories

- Sealed Lead Acid Battery
- Hands-Free Multifunction Defib Electrode Cable
- ECG Patient Cable (3 lead)
- Disposable Monitoring Electrodes (5)
- Rolls of printer paper (2)
- Instructions for Use
- Quick Reference Card
- User Training Workbook
- Test Load
- AC Power Cord

Ordering Option Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OB3</td>
<td>Service Manual</td>
</tr>
<tr>
<td>OBP</td>
<td>User Training Video</td>
</tr>
<tr>
<td>C01</td>
<td>SpO₂ Monitoring with adult reusable transducer</td>
</tr>
<tr>
<td>C02</td>
<td>Non-invasive Pacing</td>
</tr>
<tr>
<td>C03</td>
<td>12-pin, 5 lead ECG Cable</td>
</tr>
<tr>
<td>C05</td>
<td>User Training CD-ROM</td>
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<tr>
<td>C07</td>
<td>Hands-free cable M3507A (barrel connector) and Test Load (M1781A - barrel connector)</td>
</tr>
<tr>
<td>C08</td>
<td>Hands-free cable (M3508A - flat connector) and Test Load (M3725A - flat connector) - Default option</td>
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<tr>
<td>C10</td>
<td>Data Card</td>
</tr>
<tr>
<td>C13</td>
<td>External paddles with Paddle Contact Indicator</td>
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<tr>
<td>C24</td>
<td>External Sterilizable Paddles</td>
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<tr>
<td>J03</td>
<td>12-pin Sync Cable</td>
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<tr>
<td>W18</td>
<td>Extends 1-year CE On-site to 2-Year CE On-site Warranty</td>
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<tr>
<td>W19</td>
<td>Extends 1-year CE On-site to 3-Year CE On-site Warranty</td>
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<tr>
<td>W20</td>
<td>Extends 1-year CE On-Site to 5-Year CE On-site Warranty</td>
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<tr>
<td>WA0</td>
<td>Provides a 5-year unit exchange warranty (U.S./Canada only)</td>
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<tr>
<td>WA1</td>
<td>Converts standard warranty to a 5-year BioMed Warranty (U.S. only)</td>
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Upgrades/Supplies/Accessories

Upgrades

- M4738A Pacing Upgrade
- M4739A SpO₂ Upgrade

External Paddles

- M4745A Sterilizable External Paddles
- M4746A External Paddles with PCI
<table>
<thead>
<tr>
<th>Internal Paddles</th>
<th>ECG Cables</th>
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<tbody>
<tr>
<td>M1741A 7.5 cm Switchless</td>
<td>M1500A 3-Lead ECG Trunk Cable (AAMI)</td>
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<tr>
<td>M1742A 6.0 cm Switchless</td>
<td>M1663A 10-Lead Trunk Cable</td>
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<tr>
<td>M1743A 4.5 cm Switchless</td>
<td>M1668A 5-Lead Trunk Cable</td>
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<tr>
<td>M1744A 2.8 cm Switchless</td>
<td>M1669A 3-Lead Trunk Cable</td>
</tr>
<tr>
<td>M4741A 7.5 cm Switched</td>
<td>M1949A 10-Lead Trunk Cable</td>
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<tr>
<td>M4742A 6.0 cm Switched</td>
<td>M1605A 3-Lead ECG Patient Cable with Snaps (AAMI)</td>
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<tr>
<td>M4743A 4.5 cm Switched</td>
<td>M1671A 3-Lead ICU Grabber (AAMI)</td>
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<tr>
<td>M4744A 2.8 cm Switched</td>
<td>M1672A 3-Lead ICU Grabber (IEC)</td>
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<tr>
<td>M4740A Internal Paddles</td>
<td>M1673A 3-Lead ICU Snap (AAMI)</td>
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<td>Adapter Cable</td>
<td>M1674A 3-Lead ICU Snap (IEC)</td>
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<th>Pads/Electrodes</th>
<th>Sync Cables</th>
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<tr>
<td>M3713A HeartStart Multifunction Adult Plus</td>
<td>M1783A 12-pin Sync Cable</td>
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<td>M3716A HeartStart Multifunction Adult Radiolucent</td>
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<td>M3717A HeartStart Multifunction Pediatric Plus</td>
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<tr>
<td>M3718A HeartStart Multifunction Adult Radiotransparent/Reduced Skin Irritation</td>
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<tr>
<td>M3719A HeartStart Multifunction Pediatric Radiotransparent/Reduced Skin Irritation</td>
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<td>M3501A Multifunction Defib Adult Electrode, AAMI</td>
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<td>M3502A Multifunction Defib Adult Electrode, IEC</td>
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<td>M3503A Multifunction Defib Pediatric Electrode, IEC</td>
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<tr>
<td>M3504A Multifunction Defib Pediatric Electrode, AAMI</td>
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<tr>
<td>DP2 HeartStart AED Defibrillation Pads (2 pack)</td>
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<td>DP6 HeartStart AED Defibrillation Pads (6 pack)</td>
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<tr>
<th>Pads/Paddle Cables</th>
<th>SpO2 Sensors/Cables</th>
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<tr>
<td>M3507A Multifunction Defib Pads Connector Cable</td>
<td>M1191A Adult Reusable SpO2 Sensor</td>
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<td>M3508A HeartStart Pads Connector Cable</td>
<td>M1192A Pediatric Reusable SpO2 Sensor</td>
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<tr>
<td>05-10200 Pads Adapter (use with M3507A)</td>
<td>M1194A Adult/Pediatric Ear Clip, Reusable SpO2 Sensor</td>
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<td>M4748A Adapter Extension Cable</td>
<td>M1941A 2-meter extension cable</td>
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<th>ECG Monitoring Electrodes</th>
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<tr>
<td>M2202A High Tack Foam ECG Electrode 5 electrodes/ pouch (300 electrodes/case)</td>
<td>M1943A Nellcor SpO2 Sensor Adapter Cable</td>
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<tr>
<td>M1131A Disposable SpO2 Sensor - Adult/Pediatric</td>
<td>M1903B Disposable SpO2 Sensor - Pediatric Finger (Available outside the U.S. only)</td>
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<tr>
<td>M1904B Disposable SpO2 Sensor - Adult Finger (Available outside the U.S. only)</td>
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Specifications

General

Dimensions: 19.0 cm (H) x 37.6 cm (W) x 34.6 cm (L) (7.5 in. x 14.8 in. x 13.7 in.)

Weight: 6.0 kg (13.3 lbs.) including battery and full roll of paper.

Defibrillator

Waveform: Biphasic Truncated Exponential. Waveform parameters adjusted as a function of patient impedance.

Shock Delivery: Via multifunction defib electrode pads or paddles.

Delivered Energy Accuracy:

<table>
<thead>
<tr>
<th>Selected Energy</th>
<th>Delivered Energy (J)</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>Load Impedance (Ohms)</td>
<td>25</td>
<td>50</td>
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<tr>
<td>25</td>
<td>4.7</td>
<td>5.0</td>
</tr>
<tr>
<td>50</td>
<td>9.3</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>18.6</td>
<td>20</td>
</tr>
<tr>
<td>300</td>
<td>27.9</td>
<td>30</td>
</tr>
<tr>
<td>500</td>
<td>46.7</td>
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</tr>
<tr>
<td>1000</td>
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<td>100</td>
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<td>1400</td>
<td>140.3</td>
<td>150</td>
</tr>
<tr>
<td>2000</td>
<td>187</td>
<td>200</td>
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</table>

Charge Time: Less than 3 seconds to 200 Joules with a new, fully charged M3516A SLA battery pack at 25°C. Less than 15 seconds to 200 Joules when powered by AC with no battery installed.

Patient Impedance Range:

Minimum: 10-25 Ohm, depending upon energy level
Maximum: 180 Ohm

Manual Mode


Indicators: LCD display for ECG waveforms and text prompts, Audio alerts, QRS Beeper, Charging tones (for sync and asynchronic modes), AC Power LED, Battery Charging LED, Sync LED, Pacer LED.

Armed Indicators: Charge Done tone and available energy indicated on display.

Energy Selection: Front panel rotary knob.

Charge Control: Front panel “2” key or buttons on paddles.

Shock Control: Front panel “3” key or buttons on paddles.

Synchronizer: SYNC message appears on the monitor and is annotated on the printer (if printing while in Sync mode). An audible beep sounds with each detected R-wave while a tick mark on the monitor and printed strip indicate the discharge points.
Synchronizer delay is less than 60 msec from peak R-wave to peak current of the defibrillation discharge.

**AED Mode**

AED Energy Profile: Fixed energy (150 Joules).

AED Shock Series: 1, 2, 3, 4 shocks per series.

Shock Series Timer: off, 30, 60, 90, 120, 150, 180, or 210 seconds.

Text and Voice Prompts: Extensive text/audible messages guide user through protocol.

AED Controls: On, Off, Pause/Resume, Analyze/Stop Analysis, Shock, Lead Select, SpO₂ On/Off, SpO₂ Alarms, HR Alarms, ECG Gain, Volume, Strip, Summary Mark.

Indicators: LCD display for ECG waveforms and text prompts, Audio alerts, voice prompts, QRS Beeper, Charging tones, Charge Done Tone, Printer, AC Power LED, Battery Charging LED.

Armed Indicators: Charge Done tone, available energy indicated on display; Voice Message.

Patient Analysis: Per protocol, evaluates patient ECG and signal quality to determine if a shock is appropriate and evaluates connection impedance for proper defibrillation pad contact.

Shockable Rhythms: Ventricular fibrillation with amplitude greater than 100 uV and wide complex ventricular tachycardia with rates greater than 150 bpm.

Sensitivity and Specificity: Meets AAMI guidelines.

**ECG Monitoring**

Inputs: Single channel ECG may be viewed on display and printed.

Pads ECG is obtained through 2 multifunction defibrillation electrode pads. Lead I, II, or III is obtained through the 3-lead ECG cable and separate monitoring electrodes. With a 5-lead cable, lead aVR, aVL, aVF, and any one of the V (1-6) leads can also be obtained.

Lead Fault: LEADS OFF message and dashed line appear on the display if an electrode or lead wire becomes disconnected.

Paddle Fault: NO PADDLES CONNECTED message and dashed line appear on the display if paddles become disconnected.

Pad Fault: PADS OFF message and dashed line appear on the display if the pads become disconnected.

Heart Rate Display: Digital readout on display from 15 to 300 bpm, with an accuracy of ±10%.

Heart Rate Alarms: Configurable pairs of low and high heart rate alarm limits: 30 to 100, 60 to 140, 90 to 160 and 120 to 200 bpm.

Hands Free Defibrillation Cable Length: 7 ft. (2.13 m).

ECG Cable Length: 12 ft. (3.7 m).

Common Mode Rejection: Greater than 90 dB measured per AAMI standard for cardiac monitors (EC 13).

ECG Size: 2.5, 5, 10, 40 mm/mV.

Frequency Response:

AC Line Filter: 60 Hz or 50 Hz.

Pads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Pads ECG for Printer: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Leads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz) or Monitor (.15-40 Hz).

Leads ECG for Printer: Diagnostic (.05-150 Hz) or EMS (1-30 Hz) or Monitor (.15-40 Hz).

Patient Isolation (defibrillation proof):

ECG: Type CF
SpO₂: Type CF
Defib: Type BF

**Display**

Type: LCD - TFT Color Liquid Crystal Display.

Size: 111.4 mm x 83.5 mm.

Resolution: 320 x 240 pixels.

Sweep Speed: 29 mm/s nominal (stationary trace; sweeping erase bar).

Viewing Time: 4 seconds.

**Battery**

Type: 2 Ah, 12V, rechargeable, Sealed Lead Acid.

Dimensions: 2.4 in. (H) x 0.94 in. (W) x 7.2 in. (D) (61.7 mm x 23.9 mm x 182 mm).

Weight: 1.4 lbs. (0.65 kg)

Charge Time: Approximately 14.5 hours to 100%. Approximately 3 hours to 90%, indicated by LED on front panel.

Capacity: 100 minutes ECG monitoring or 50 full-energy discharges or 75 minutes ECG monitoring while pacing (with a new, fully charged battery at room temperature, 25º C).
Battery Indicators: LOW BATTERY message appears on display when at least 10 minutes of monitoring time and 5 maximum energy discharges remain (with a new battery at room temperature, 25º C).

Battery Storage: Should not be stored above 40ºC for extended periods of time.

Charger Output: Unit can be operated using only AC Power; with no battery installed.

Thermal Array Printer

Continuous Real-Time Strip: User starts and stops the strip. The strip prints the selected ECG lead with the following data:

Header 1: Date, Time, Heart Rate, the SpO₂ Value (if available) and the text “Delayed” if printing has been configured for Delayed Mode. Prints every 12 seconds.

Header 2: Current mode (AED/Manual), Lead, Gain, filter setting, the text “Sync” (if Sync has been enabled), and Pacer Settings (consisting of the Pacer Mode, Rate and Current, if presently pacing the patient). Prints every 12 seconds with Header 1.

Header 3: Changes in Mode, Gain, Lead, Sync, and Pacer Settings.


Symbols: Mark Triangle (for presses of the Mark key), an Alarm Bell (Alarm Limits Violations), Lightning Bolt (Shock Delivered; followed by “b” for biphasic), Vertical Strip Boundaries/Pacer/Sync Tick marks.

Event printing: Mark key automatically documents ECG and events during defibrillation episodes. The Mark key can annotate the event with one of the following labels: Epinephrine (Adrenaline in U.K. and Australia), Atropine, Lidocaine or Other.

Auto Printing: The printer can be configured to automatically print on Mark, Charge, Shock and Alarm.

Delayed Printing: The printer can be configured to run real time or with a 6 second delay.

Reports: The following can be printed: Event Summary, Configuration, Extended Self Test, System Log, Battery Capacity Test, Shift/System Check.

Speed: 25 mm/s with an accuracy of ± 5%.

Amplitude Accuracy: ± 10% or ± 50 uV, whichever is greater.

Paper Size: 50 mm by 30 m (100 ft.).

Noninvasive Pacing

Waveform: Monophasic Truncated Exponential

Current Pulse Amplitude: 10 mA to 200 mA (5 mA resolution); accuracy 10 mA to 50 mA ± 5 mA, 50 mA to 200 mA ± 10%.

Pulse Width: 20 ms with accuracy ±0.5 ms.

Rate: 30 ppm to 180 ppm (10 ppm increments); accuracy ± 1.5%.

Modes: Demand or Fixed Rate

Refractory Period: 340 msec (30 to 80 ppm); 240 msec (90 to 180 ppm).

SpO₂ Pulse Oximetry

Accuracy with:

M1191A sensor - 1 standard deviation 70% to 100%, ± 2.5%
M1192A sensor - 1 standard deviation 70% to 100%, ± 2.5%
M1194A sensor - 1 standard deviation 70% to 100%, ± 4.0%
M1131A sensor - 1 standard deviation 70% to 100%, ± 3.0%
M1903B sensor - 1 standard deviation 70% to 100%, ± 3.0%
M1904B sensor - 1 standard deviation 70% to 100%, ± 3.0%

Pulse Rate Accuracy: 2% or 1 bpm (whichever is greater).

Wavelength Range: 500 to 1000 nm.

Emitted Light Energy: Less than or equal to 15 mW.

Display Update Interval: Less than or equal to 60 seconds.

Resolution: 1%.

SpO₂ Alarm Limits: Three preset low alarm limits: 90%, 85% and 80%.

INOP Alerts: Triggered by disconnected sensor, noisy signal, light interference or low signal (non-pulsatile).

Event Storage

Internal Event Summary: The Internal Event Summary stores up to 300 events and up to 50 waveforms.

Events can be marked with a Mark symbol and, if configured for drug annotation, the following labels can be added: Epinephrine (Adrenaline in U.K. and Australia), Atropine, Lidocaine or Other.

The Summary key on the front panel is used to print the internal Event Summary.

Data Card Event Summary: The Data Card stores continuous ECG waveforms and events on a Type II PCMCIA card.
Environmental

Temperature: 0º C to 55ºC operating; -20º to 70ºC storage.

Charging the battery at temperatures above 35ºC may degrade battery life.

Storing the battery for extended periods at temperatures above 40ºC will reduce battery capacity and degrade battery life.

Humidity: Up to 95% Relative Humidity

Printer paper may jam if paper is wet.

Thermal Printer may be damaged if wet paper is allowed to dry while in contact with printer elements.

Altitude:
Operating: up to 15,000 ft.
Storage: up to 15,000 ft.

Shock: Philips Medical Systems, Section 760 Class B1 Drop Test (200 G’s <3 msec pulse).

Vibration: Philips Medical Systems, Section 759 Class B1 Vibration.

Water Resistance: Meets IEC 60601-2-4, IPX 0.

EMC: Meets EN 60601-1-2

Safety: Meets IEC 60601-1 (EN 60601-1), UL 2601-1, CAN/CSA C22.2 No. 601-1.

Other Considerations: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air, oxygen or nitrous oxide.

Mode of Operation: Continuous.

AC Line Powered: 100-240 VAC, 50/60 Hz, 1.5A (Class 1)

Battery Powered: 12 V rechargeable, SLA