Introduction

This application note describes the ECG Out cable and how to use it with a Philips ALS monitor/defibrillator and bedside monitor for:

- Synchronized cardioversion, where it is recommended to connect the cable from the monitor/defibrillator to the bedside monitor to send an ECG signal.
- Transcutaneous pacing, where you may connect the cable from the monitor/defibrillator to the bedside monitor.

The ALS monitor/defibrillator is intended to be the primary monitoring device for synchronized cardioversion and transcutaneous pacing, while the bedside monitor is intended for viewing waveforms and data; however, the monitor/defibrillator can be used alone for all stated purposes.

This note focuses on cable use with Philips ALS monitor/defibrillators and is intended for ICU, ED, and OR clinical personnel.
**Cable Description**

An ALS monitor/defibrillator (referenced further as “defibrillator”) can be connected to an external bedside monitor to send or receive an ECG signal between the two devices. Simply put, the ECG Out cable makes this connection. It is similar to a 3-Lead cable in that it delivers one primary analog ECG signal (or waveform), in this case from the defibrillator to the bedside monitor or from the bedside monitor to the defibrillator. Thus, the waveform on the sending device appears on the receiving device.

**NOTE:** Refer to the bedside monitor manufacturer’s instructions for use or service documentation for specific details on using the cable for ECG Out from the monitor.

Defibrillator’s ECG signal sent through the ECG Out cable is multiplied 1000 times to keep the signal-to-noise ratio high and then is divided by 1000 prior to entering the ECG port. Also, the signal is classified as monitor bandwidth only (i.e., not diagnostic quality).

Current Philips’ ECG Out (sync) cables are comprised of:
- a phono plug that connects to an ECG Out port,
- a cable that transmits one ECG signal through two wires (one signal/one ground), and
- a 12-pin connector that attaches to an ECG In port.

The cable comes in two lengths: 8 and 25 feet. The following figure depicts the ECG Out cable and appropriate connections:

![ECG Out Cable Diagram](image)

**NOTE:** Above cable length is not to scale.

**WARNING:** Modification to the ECG Out cable is not supported.

The following table lists the various ECG Out cables available and which defibrillators they can be used with:

<table>
<thead>
<tr>
<th>Cable No.</th>
<th>Defibrillator</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1783A</td>
<td>M3535A/M3536A (HeartStart MRx)</td>
<td>2.5m</td>
</tr>
<tr>
<td></td>
<td>M4735A (HeartStart XL)</td>
<td>(8 ft.)</td>
</tr>
<tr>
<td>M5526A</td>
<td>M3535A/M3536A (HeartStart MRx)</td>
<td>7.8 m</td>
</tr>
<tr>
<td></td>
<td>M4735A (HeartStart XL)</td>
<td>(25 ft.)</td>
</tr>
</tbody>
</table>

The defibrillator ECG Out cable can be used with any lead set, depending on the specifications of the bedside monitors and defibrillators involved. Its intended use is to deliver an ancillary ECG signal to the bedside monitor or defibrillator. It is not intended to be used as a primary monitoring ECG source.

Keep in mind the following device characteristics:
- The defibrillator will send (output) a waveform associated with the lead that is selected as the primary lead on the defibrillator.
- The bedside monitor must be set to Lead II. This is the only setting that will accurately display the waveform being sent by the defibrillator.
- Despite the Lead II label on the bedside monitor, the waveform displayed will be the primary ECG on the defibrillator. To avoid any confusion when viewing waveforms, it is recommended that the defibrillator also be set to Lead II, if clinically possible.

**NOTE:** ECG Out cable is not supported with EASI monitoring.
Synchronized Cardioversion

When using an ECG Out cable during synchronized cardioversion therapy, complete the following procedure to send the ECG signal from the defibrillator to the bedside monitor:

1. Plug the phono plug firmly into the ECG Out jack on the defibrillator.
2. Plug the pin connector firmly into the ECG port on the bedside monitor.
3. Select Lead II as the primary lead on both the defibrillator and bedside monitor.

If using only multifunction electrode pads, the ECG Out cable is not needed since you can use the pads from the defibrillator to monitor the patient and provide therapy as needed. However, in the event the ECG Out cable is used with multifunction electrode pads, it is important to note that an anterior-anterior pad placement will provide a waveform similar to ECG Lead II. Pads in any other placement may not provide a standard view.

**NOTE:** To optimize synchronized cardioversion, Philips recommends the ECG signal go directly from the patient to the defibrillator to reduce the potential of a signal delay. Philips does not recommend using an ECG signal obtained by a bedside monitor as the ECG signal for synchronized cardioversion.

**WARNING:** If you use the bedside monitor as the ECG source, a biomedical engineer MUST verify that the monitor and the ALS defibrillator combination will deliver a synchronized shock within 60 ms of the peak of the R-wave. This can be verified by using a 1 mV QRS complex with a QRS width of 40 ms. This performance cannot be guaranteed with all commercially available monitors. *These statements are based on 1996 AAMI (Association for the Advancement of Medical Instrumentation) Standard 4.3.17 Synchronized discharge.*

Transcutaneous Pacing

When performing non-invasive transcutaneous pacing therapy, ECG Out cable use is limited based on the pacing mode.

**Demand Mode**

In demand mode, the patient must be monitored from the defibrillator as the primary monitor and the ECG signal may be sent to the bedside monitor for display and recording purposes only. So, you must connect:

1. the phono plug on the ECG Out cable to the ECG Out jack on the defibrillator and
2. the pin connector to the ECG port on the bedside monitor.

With demand mode pacing, multifunction electrode pads and monitoring electrodes are required and since pacing therapy is being delivered according to the QRS being read on the defibrillator, there can be no delays in acquiring the QRS. **The ECG signal must go directly from the patient to the defibrillator. Sending the signal from the patient to the bedside monitor to the defibrillator is not supported due to potential signal delay.**

**Fixed Mode**

During fixed mode pacing, no ECG signal is required. Thus, the ECG Out cable is not needed for this procedure.